October 1993 Issue #27

BULK RATE
U.S. POSTAGE
PAID
PERMIT #1
MANCHESTER, NH

Radio Fun

"The beginner's guide to the exciting world of amateur radio."

in this issue

features

reviews

kit reviews

vintage reviews

departments

President Clinton To Ham Astronauts: "Good Job!"

President Bill Clinton praised the astronauts aboard NASA shuttle mission STS-57 on a special live hookup to the White House recently. He told the crew their work on the Shuttle Amateur Radio EXperiment (SAREX) was inspiring to young Americans. For more on the story, please turn to "Clinton is High on Hams in Space" on page 16. (Photo courtesy: The White House.)

FCC Relaxes Business Restrictions

The Federal Communications Commission has enacted a major change in the law restricting amateur radio use for personal business and public service. Under the new rules, it will no longer be a violation to order a pizza or make an appointment via amateur radio. The Commission has acted to amend the Part 97 Amateur Service rules allowing for more flexibility in personal business and public service communications.

The amendment permits licensees to use the amateur service frequencies to assist with public service communications at races, parades, and educational activities. Personal communications which will no longer be prohibited include making appointments, ordering food, and collecting data for the National Weather Service.

Effective 30 days after publishing in the Federal Register (approximately September 15th), here is what you can do (with some exceptions) on the ham bands:

Any amateur-to-amateur communications are now permitted unless:

a. Specifically prohibited. These include:

1. Music (except for incidental space shuttle music);

2. Communications facilitating a criminal act;

3. Messages obscured by codes or ciphers;

4. Obscene or indecent words or language; and

5. False or deceptive messages, signals, or identification.

b. Transmissions for compensation. The following exceptions apply:

1. Morse code practice and information bulletins (special criteria);

2. Classroom teachers using ham radio in the classroom.

c. Transmissions for the pecuniary benefit of the station control operator or his or her employer.

The following communications are permitted, but not on a ". . . regular basis" (not defined by the FCC):

1. Communications which could be reasonably furnished through other radio services;

2. Notices concerning sale or trade of amateur station apparatus; and

3. Retransmissions of government-provided space shuttle, propagation, and weather forecast broadcasts.

Here are some examples of the old and new part 97.113, which covers prohibited communications:

OLD RULE: No amateur station shall transmit any communications which promotes the business or commercial affairs of any party. If anyone profits financially, it is an illegal transmission.

NEW RULE: An amateur may not be paid, direct or indirect, for his voluntarily provided communications.

Continued on page 16

Put yourself in the winner's circle

with the PK-232MBX multi-mode controller.

The PK-232MBX sets the pace for multi-mode controllers. While the competitors are racing to catch up, the PK-232MBX surges into the lead, winning more contests and providing the best value of any multi-mode controller on the market today.

Leave the competition in the dust—with the highest quality filters available (seventeen-pole effective filtering), the PK-232MBX pulls signals out of the noise better than any other controller.

Satisfy your drive for variety with PACTOR, Packet, AMTOR/SITOR, Morse, RTTY (Baudot/ASCII), WEFAX, NAVTEX, and TDM modes.

You won't spin your wheels trying to identify a signal. Our revolutionary SIAM™ technology automatically identifies the incoming signals, switches the PK-232MBX to the recognized mode, and starts displaying the data.

PACTOR, Packet and AMTOR mailboxes—with selective control of third party traffic—are standard to the PK-232MBX.

Our extensive Host Mode control gives you unmatched power and versatility from computer support programs for DOS, Windows™, Macintosh, and Commodore computers.

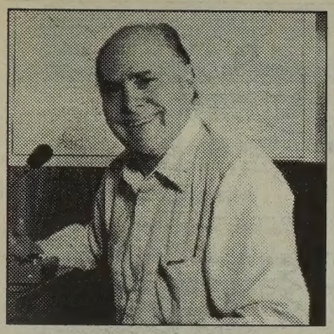
Our highly trained service crew keeps you on track with helpful advice and in-depth knowledge of amateur radio.

When you're ready for a multi-mode controller with a proven track record, the PK-232MBX is the choice of champions.

For more information on the PK-232MBX, call AEA's Literature Request Line at (800)432-8873 or contact your favorite ham radio equipment dealer.

AEA

Connect with us



QLF

by Wayne Green W2NSD/1

How G.E. bumbled away a billion dollars . . . and fumbled history!

It was a few years ago. Almost 30 years, actually, and amateur radio was right in the middle of this piece of history. I wonder how many amateurs remember what happened back then. Lean back and old Uncle Wayne will spill the beans.

This had to do with the beginnings of single-sideband. It was known as single-sideband suppressed carrier in the early days (SSSC). SSB had actually been around for many years and had been used for some commercial point-to-point communications. But it was a kluge to use. This was before phasing circuits had been invented, so they took an AM signal and got rid of the second sideband and the carrier with filters. In the antenna! For any amount of power this meant big water-cooled filters.

But receivers weren't very stable back then, either. They'd often drift maybe 5-10 kc (this was before Hertz) during the warm-up, so we had to keep retuning our receivers until they warmed up and stabilized. Transmitters would have drifted too, but this was before the invention of stable variable oscillators, so we used crystals. That kept our transmitters on channel, even while the tubes, capacitors, and coils were warming up.

Radar timing circuits used phase-shifting circuits, so it wasn't long after these were declassified after WWII that someone thought of using the circuit to cancel out both the second sideband and the carrier. Voilà, SSSC. The first circuit was developed by a ham, of course. I built my first SSB rig in 1954. That was back when I still had enough time to build my own gear.

Now, at about the same time as SSB was getting started, pioneered by Wes Schum W9DYV and his Central Electronics 10A exciter, John Costas of G.E. was working on double-sideband suppressed carrier (DSB-SC). G.E. came out with a commercial DSB receiving detector. Now I wish I'd saved mine.

If you're not familiar with sideband technology, it's simple. Our old amplitude modulated (AM) rigs had a carrier, plus upper and lower sidebands. Two-thirds of the power went into the carrier and one-third into the two sidebands. So, by getting rid of the carrier and one sideband a rig could run six times as much effective output power. Six times the punch. Then the carrier would be generated at the receiver and mixed with the sideband. By this time we had enough receiver stability to make this system work.

Two other big benefits were that this got rid of those miserable carriers, which created beat notes when two were within 20 kc of each other, which they always were. It made the phone bands madhouses of heterodynes, wiping out all but the loudest signals. By transmitting only one sideband, the width of the signal was cut in half, making it possible for us to have more contacts in our narrow phone bands.

While receivers did best when they had a sideband detector, it was possible to use the receiver BFO to simulate the missing carrier, so that's the way we did it at first. I remember visiting hams in Germany, Austria, and Switzerland in 1958 and showing them how they could tune in sideband signals.

But what about this double-sideband stuff? Why would anyone want to transmit two sidebands and occupy twice as much of the band when one sideband was doing so well? That also cut your power in half. The benefits of DSB were not obvious. But the fact is that DSB had an enormous benefit over SSB. It was all in the detector. Let me explain.

With DSB you're transmitting two identical signals, one above the center frequency and one below. Now let's suppose you have two detectors in your receiver, one for each sideband. And then let's use a little gate which will open only when the same signal comes through on both sidebands at once. The result is that you can run signals much closer together in frequency with a minimum of interference. And so, although each transmitter seems to take up twice the bandwith, you can run around five to 10 times as many signals in the same band with DSB . . . depending on the differences in signal strengths.

G.E. knew this and Costas was trying to get them to support this new technology. At the same time Art Collins WØCXX was pushing SSB for commercial and military communications systems. Art enlisted the help of Don Merten W2UOL/K2AAA to get the military to specify SSB, which he figured (rightly) would be worth a fortune to Collins radio. I'd known Don ever since he'd been selling surplus gear right after the war from his home as Eldico Electronics in Whitestone NY.

They went after General Curtis Lemay, the head of SAC, and General Butch Griswald, his second in command (both hams, naturally). Art set up Collins SSB equipment on Curt's SAC plane, in his office, on his boat, in his home, and so on. Then they climbed aboard a SAC plane and showed Curt and Butch how, for the first time, they could keep in touch with their planes from just about anywhere in the world. SSB beat the hell out of AM and Collins was in. Art brought out the 75A1 receiver and the 32V1 transmitter and made millions. Hundreds of millions. Billions in today's dollarettes.

Don later went into the sideband manufacturing business too, building Eldico rigs.

When the 75A1 came out it was by far the most expensive receiver on the market. I looked at it and predicted it would never sell. That's by far the worst prediction I've ever made. Within a few years it was the most popular ham receiver in the country. And then in the world.

If G.E. had had anyone with vision, they'd have gone after the military market with their DSB system, and gone after it via amateur radio, the way Art Collins did. They had the technically better system, by far, but they goofed it and the rest is history. Oh, I published a few articles on DSB, but it was too late, SSB had won. Without receivers with DSB detectors built in the system was useless.

I mentioned AM, which died a well-deserved death. One thing few amateurs have yet caught on to is that the mode is not really amplitude modulated at all. When you look at an AM signal on an oscilloscope you can see the carrier wave and watch it being modulated, so it looks for all the world like this is what's happening. It isn't. Sometimes you can't believe what you're seeing.

What's actually happening is this. You have an RF final amplifier in the transmitter. This is modulated by the audio signal. If you have a kilowatt of carrier you need 500 watts of audio to modulate it fully. What really happens is that your final amplifier is acting as a mixer. You feed in your carrier frequency and the audio frequencies. The result is what you get from any mixer: the original two frequencies, the sum of them, and the difference. The original audio frequency gets lost in the final tuning and antenna circuits, so all that is transmitted is the carrier frequency, plus the sum and difference frequencies . . . known as the sidebands. The total output is the 1,500 watts you put in, less what's lost in the circuit.

It wasn't until scientists were able to develop very sharp tuning receivers that they discovered that the carrier didn't actually vary with modulation. Everyone had always believed what the oscilloscope seemed to show. Some old-timers will still argue about this, but only if they aren't well read.

If G.E. had gone after the golden ring we'd be able to have several times as many signals on our HF bands and far less interference. Too bad. RF

Resonance

by Larry Luchi W7KZE

[Editor's Note: This technical discussion of resonance is a bit more advanced than what we usually publish in Radio Fun, *and it may leave some of you in the dark. If so, read it through a few times—slowly—and things should begin to sink in. If you want to get the most out of amateur radio, you've got to really understand this stuff—not just memorize a bunch of answers for a test. We've asked Mr. Luchi to prepare a series of articles focusing on various electronic components and their properties. We'll publish them from time to time, and if you stick with them, you'll be well on your way to a solid foundation in electronics.—David N1GPH]*

Resonant circuits are at the heart of all transmitters, receivers, and antennas. Without resonant circuits there would be no radio communication.

Brief mention was made of resonance in my last article. When the inductive reactance (X_L) of a coil equals the capacitive reactance (X_C) of a capacitor in a circuit, a condition known as resonance occurs. Figure 1a illustrates a series-resonant circuit and Figure 1b shows a parallel-resonant circuit.

Since resonance is the condition where X_L equals X_C, the formula for resonance is:

$$X_L = X_C \text{ or } 2\pi fL = \frac{1}{2\pi fC} \quad \text{Equation 1}$$

Where X_L = inductive reactance, in ohms

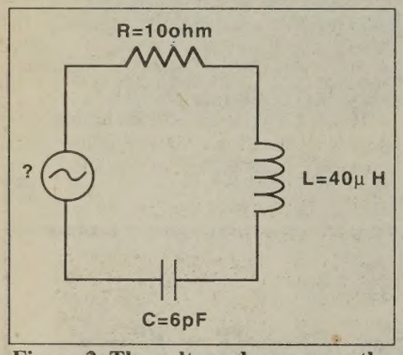


Figure 2. The voltage drop across the coil and the capacitor is zero. The total source voltage appears across R.

X_C = capacitive reactance, in ohms
f = frequency, in hertz
L = inductance, in henries
C = capacitance in farads

Equation 1 shows that the inductive reactance is directly proportional to frequency, and that capacitive reactance is inversely proportional to frequency. With any given coil and capacitor, as the frequency increases the reactance of the coil increases but the reactance of the capacitor decreases. At some frequency, the two reactances will be equal in value. At this exact frequency resonance occurs. At all other frequencies the circuit shown in Figure 1a is merely a series AC circuit, and Figure 1b is just a simple parallel AC circuit.

To find the frequency at which a coil and capacitor will resonate, the resonance formula may be rearranged to solve for f:

$$f_r = \frac{1}{2\pi\sqrt{LC}} \quad \text{Equation 2}$$

This formula can be used to find the resonant frequency of any LC circuit. For example, if we have an X_L of 1,070 ohms and an X_C of 1,068 ohms, we can see that L and C are at a resonant frequency. [$X_L \approx X_C$ (close enough)]Using the above formula with an inductor of 8 μH and capacitance of 7 pF, we can solve for the resonant frequency.

When using Equation 2 with a calculator, use the [EE] or [EXP] key for the exponent (power of 10). Your calculator will then default to a positive exponent. The sign change key [+/-] will change to a negative exponent for millihenries, 10^{-3} or microhenries, (10^{-6}) or picofarad (10^{-12}). [ENG] key changes any exponent to a metric value, which is to say any exponent that can be divided by three. All of the above exponents are [ENG]. Practice with the following example:

Example 1:

ENTER	DISPLAY
[CE/C]	0
8 [EXP] [+/-] 6 [X]	0.000008
7 [EXP] [+/-] 12 [=]	5.6^{-17}
[2nd] [√]	0.000000007
[X] [6.28] [=]	0.0000000046
[1/X]	21278761.3
[2nd] or [EE]	21.3^{6} or 21.3 MHz

According to the formula, the frequency at resonance is inversely proportional to the square root of either L or C. Any time the LC product is decreased to one-quarter by any means the frequency will be doubled.

Any time the LC product is increased four times—by quadrupling L, by quadrupling C, by doubling both L and C, or by any other means—the frequency will be one-half of the original.

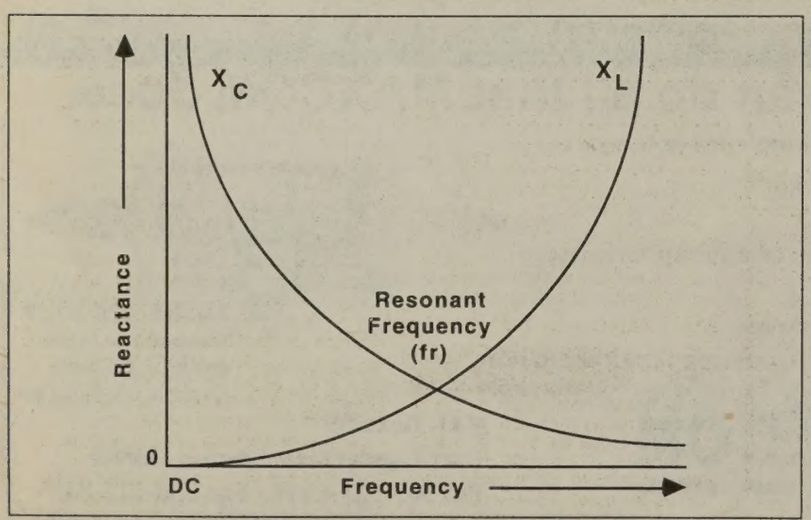


Figure 3. Resonance occurs where $X_C = X_L$.

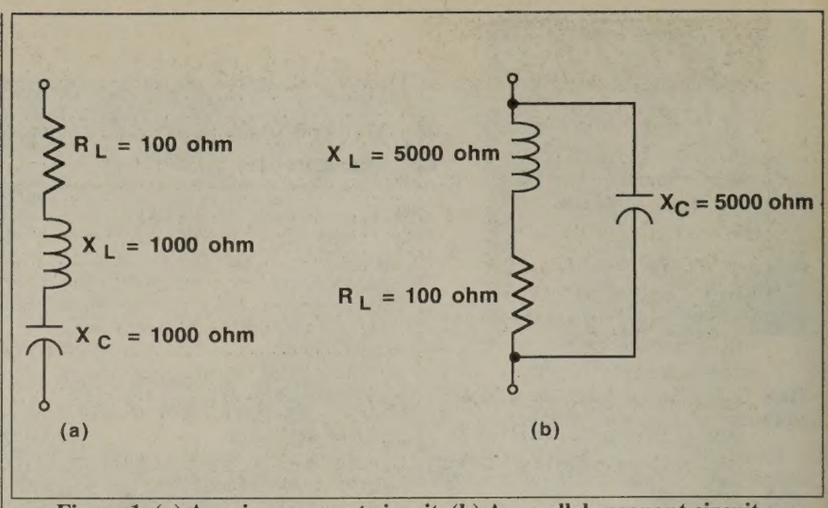


Figure 1. (a) A series-resonant circuit. (b) A parallel-resonant circuit.

Series Resonant Circuits

In any series circuit containing both L and C, the circuit current is greatest when the inductive reactance X_L equals the capacitive reactance X_C. Because, under those conditions, the impedance is equal to R. When resonance occurs, the reactances are equal, and we can derive an equation to calculate the resonant frequency of any inductor-capacitor pair using Equation 2.

If the source sees the coil and capacitor together as having a zero voltage-drop across them, it sees them as perfect conductors, or as having zero impedance (Figure 2).

If the reactances are not exactly equal (a nonresonant condition), the voltages do not exactly cancel. The source sees the two reactances as having a resultant voltage-drop across them and therefore as having some value of reactance or impedance.

Theoretically, if a series LC circuit has no resistance, and is connected across a source of AC to which it is resonant, it presents zero reactance, zero resistance, zero impedance, and infinite current!

Continued on page 6

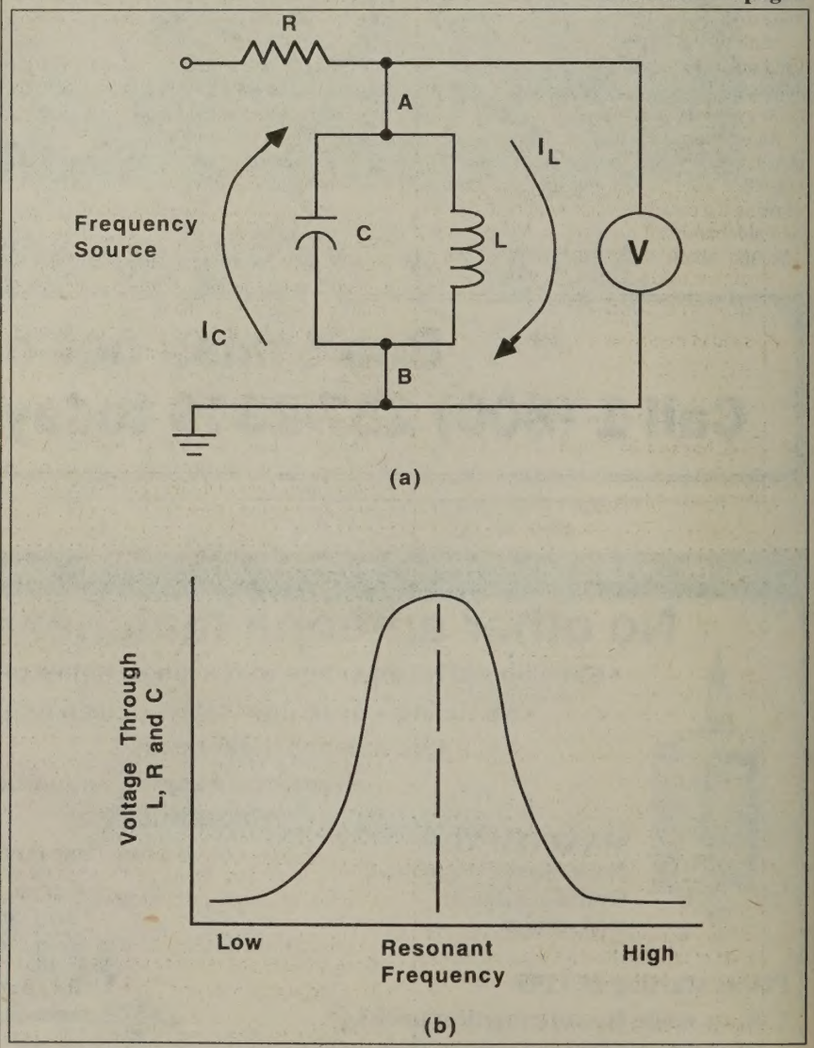


Figure 4. (a) Parallel-resonant circuit. (b) *Voltage maximum* at resonance.

Radio Fun

OCTOBER 1993
issue #27

editor/publisher
Wayne Green W2NSD/1
associate publisher
David Cassidy N1GPH

managing editor
Hope Currier
senior/technical editor
Charles Warrington WA1RZW
editorial associates
Sue Jewell
Joyce Sawtelle
contributing editors
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Carole Perry WB2MGP
Jeffrey Sloman N1EWO
Gordon West WB6NOA

advertising sales representative
Dan Harper
advertising coordinator
Judy Walker

603–924-0058
800–274-7373
FAX 603-924-9327

graphic design
Suzanne Self

desktop page make-up
Linda Drew

circulation manager
Harvey Chandler
subscription services
800-257-2346

Wayne Green, Inc.
editorial offices
Radio Fun
70 Route 202-North
Peterborough, NH 03458
603-924-0058
FAX: 603-924-9327

RADIO FUN (ISSN 1055-887X) is published monthly by Radio Fun, a division of Wayne Green, Inc., 70 Route 202-N, Peterborough NH 03458. Subscriptions: $14.00 per year. Canada add $8.00. Foreign add $12.00 surface/$32.00 airmail. Second class postage pending at Peterborough NH and additional mailing offices.

Printed in the U.S.A. by Lighthouse Press, Manchester, NH

POSTMASTER: Send address corrections to RADIO FUN, P.O. Box 4926, Manchester NH 03108.

Reprints: $2.00 per article. Back issues: $3.00 each.

letters

Write to: Radio Fun, 70 Route 202-N, Peterborough, NH 03458

Johnny Vines KD4FTG, Bay Minette AL I am a recently licensed (less than two years) amateur radio operator. I have been a subscriber to your outstanding *73 Amateur Radio Today* and *Radio Fun* for quite some time. I am very thrilled and excited about getting them each month. Honestly—I read them from cover to cover and can hardly wait to get each issue.

I became interested in ham radio while on active duty (Desert Storm). I haven't regretted a single minute of study and preparation for obtaining my code Tech license. Wayne, I'm having a barrel of fun and I hope to upgrade to General next month.

I tremendously enjoy the technical and general information articles and I have built several projects from your magazines. I enjoy your editorials and agree with your views on several subjects. I know that you are an advocate of no-code licensing and I suppose I can share your views on that. I did learn Morse code. I enjoy code, the dits and dahs and frustrations of learning the language. I have no quarrel at all with no-code licensing but I personally chose to go the code route.

In many of your writings you strongly emphasize your opinion that code has no commercial or military value. Although Morse code may be outmoded, outdated and a slow and primitive method of communication, the Department of Defense does feel that it is the most reliable long-distance communication ever, especially in tactical situations.

The Army's Military Intelligence School at Fort Devens, Massachusetts, teaches a 22-week Morse code interceptor course. Could it be that Morse code is a basic communication method in Russian doctrine?

The Army and Marine Corps use Morse in tactical operations, and the Air Force Special Forces use Morse. Also, it is used for ship-to-ship and ship-to-shore communication.

The US Army says (*Soldier Magazine*, Feb. 1993) that Morse is still alive and well in the US Army. It has been used in every major US conflict since its invention, including Desert Storm.

. . . hmph . . . Wayne

John Thompson K6OHM, Tustin CA I read David Laustsen's letter (N3LHY) in the August issue regarding CW and licensing and, although I agree with the general theme, I would like to offer another opinion from someone who will soon celebrate 40 years of being a ham. I was licensed as a Novice soon after that class of license was introduced. I'm sure hams already licensed as Generals were opposed to reducing the entry level requirements, just as today many oppose the no-code entry level.

Somehow, ham radio still exists and, even though way back then my Novice license expired before I upgraded, I soon learned the required theory (code was no problem) to pass my General Class exam. Thirty-eight years later I decided to upgrade again and passed the Advanced and Extra exams in a period of three months.

Bob refers to Morse code as something that only old codgers would insist upon keeping and, because ships no longer use it, should be abandoned from the testing requirement. I happen to be one of many people (I'm not an old codger) who likes Morse code (about a third of my QSOs) for several reasons:

1) I can operate my rig at home even during the night (when conditions are better on some bands) and have QSOs without waking other family members. I don't know why, but they get upset when I try to raise an SSB station at 3 a.m., even though I explain the "rarity" of a DXpedition!

2) The mind is a muscle and, like our other muscles, it needs exercise. Believe me, having a QSO with someone going 20 wpm or faster gives that muscle a good workout.

3) Many stations in smaller countries can't afford SSB equipment and the only way to work them is by CW. Several countries in my DXCC total are only on CW.

4) Understanding someone who would speak in an

Continued on page 9

Resonance

Continued from page 4

Parallel Resonant Circuits

Resonance in parallel circuits occurs when $X_L = X_C$, as in series circuit resonance. In Figure 3, for a specific inductor and a specific capacitor, the point where the two curves cross ($X_L = X_C$) is called resonant frequency. When a parallel circuit has equal X_L and X_C, the external circuit current is equal to that flowing through the parallel resistance. If the circuit contains no parallel resistance, the external current is zero. A coil and capacitor connected as in Figure 4a form a parallel AC circuit. If X_L and X_C have the same reactance to the frequency of the AC source, the circuit is known as parallel resonant. In Figure 4a let X_C equal 100 ohms and X_L equal 100 ohms; with a source voltage of 100 volts we can calculate the current.

If the capacitor is temporarily disconnected, leaving the 100Ω reactance coil across the 100 V source, according to Ohm's law the AC circuit current in the coil will be:

$$I = \frac{V}{X_L} = 1 \text{ amp}$$

If the 100Ω reactance capacitor is reconnected across the coil, 1 amp of current will flow in the capacitor. In a parallel resonant circuit you read equal voltage across the coil and the capacitor. In the inductive branch, the current lags the source voltage by 90 degrees, and in the capacitive branch the current leads the source voltage by 90 degrees. Since the two currents are 180 degrees out of phase, at any instant that current is flowing down through the coil and equal current must be flowing up into the capacitor.

This circulating current flows between the two reactances, but no current flows into and out of the source. Because the source is supplying no current, it should be possible to disconnect the source and the current should continue to oscillate back and forth between the capacitor and the inductor in Figure 4a indefinitely. With no resistance or losses in the circuit, this would be true. This ability of a resonant circuit to sustain electron oscillation is known as the flywheel effect because of its similarity to the action of a mechanical flywheel, which, once started, tends to keep going until stopped by friction or other losses.

Calculating the resonant frequency of a parallel circuit is exactly the same as for a series resonance circuit.

Remember, in Figure 3, for a specific inductor and a specific capacitor, the point where the two curves cross ($X_L = X_C$) is called resonant frequency. With pure reactance and zero resistance in the circuit, the source current is zero. With resistance in series with either branch, source current increases, and reactive currents decrease. That is to say, at resonance parallel circuit voltage is at maximum!

Calculating Component Values for Resonance

We can calculate either the inductance L or capacitance C to resonate with a certain component at a specific frequency:

$$L = \frac{1}{(2\pi f_r)^2 C}$$

Example 1: What value of L resonates with a 106 pF capacitor at 1,000 kHz?

ENTER	DISPLAY
[CE/C] 0	
[(] [6.28] [X] 1 [EXP] 3 [)] [X^2]	39438400
[X] 106 [EXP] [+/-] 12 [=]	0.00418047
[1/X]	239.2075303 or 239Ω

Example 2: What value of L resonates with a 200 pF capacitor at 7,200 kHz?

ENTER	DISPLAY
[CE/C]	0
[(] [6.28] [X] 7.2 [EXP] 6 [)] [X2]	2.044486656^{15}
[X] 200 [EXP] [+/-] 12 [=]	408897.3312
[1/X]	0.000002445
[2nd] [ENG]	2.44^{-06}

Example 3: What value of C resonates with a 239 µH inductor at 1,000 kHz?

ENTER	DISPLAY
[CE/C]	0
[(] [6.28] [X] 1 [EXP] 3 [)] [X^2]	39438400
[X] 239 [EXP] [+/-] 6 [=]	9425.7776
[1/X]	0.000106092
[2nd] [ENG]	106^{-6}

Finding L from X_L: Not only can X_L be calculated from f and L, but if any two factors are known, the third can be found. Very often X_L can be determined from voltage and current measurements. With the frequency known, L can be calculated as:

$$L = \frac{X_L}{2\pi f}$$

Example 4: A coil with negligible resistance has 62.8 volts across it with 0.01A of current. What is the inductive reactance X_L?

$$X_L = \frac{V_L}{I_L} = \frac{62.8V}{0.01A} = X_L = 6{,}280\Omega$$

Example 5: Calculate the L of an inductor that has a 15,700ΩX_L at a frequency of 10 MHz.

ENTER	DISPLAY
[CE/C]	0
[(] 15,700 [)] [÷] [(]	0
6.28 [X] 10 [EXP] 6 [)]	62,800,000
[=]	0.00025
[2nd] [Eng]	250^{-06}

If this calculation is performed without parentheses, the algebraic hierarchy completes the multiplication before the addition. Without parentheses the result is 2.5^{10}H.

In my next article I will discuss impedance and the Q of a circuit. RF

My Recent Experiences with QRP

by Robert Capon WA3ULH

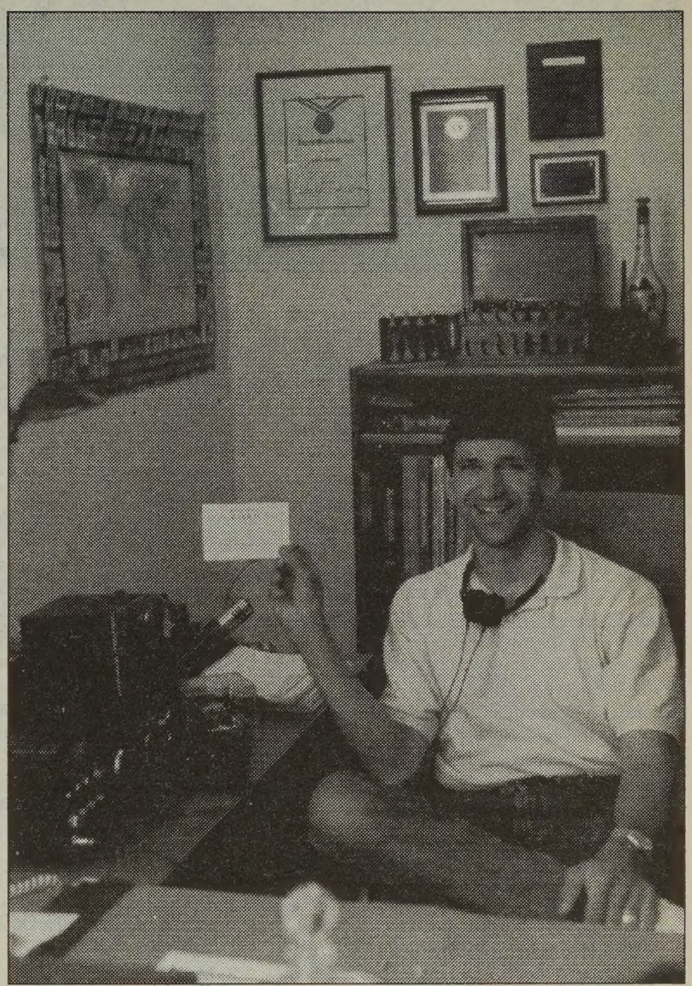


Photo A. The author, Rob WA3ULH, at his station with the MFJ-9020 QRP transceiver. He is holding the QSL card from a QSO with ZS6KO.

I launched my amateur radio "career" 19 years ago, but I only recently discovered QRP as a new facet of my hobby. During the past eight months, with 5 watts or less, I have worked all continents, worked 151 DXCC countries (102 confirmed), and established a QSO with a station in South Africa with 20 milliwatts. And I've had a terrific time.

I got started with QRP in a rather odd way. I had worked over 250 DXCC countries, and was lamenting the difficulty of finding new ones. As I told my wife and kids: "All of the *easy* countries (defined as countries inhabited by humans, not penguins, and having one or more active hams) have been worked." I was spending most of my time waiting for DXpeditions to new countries. In between DXpeditions, I was getting bored.

I reasoned that if I set a new goal, I could re-energize my enjoyment of my hobby. I made a fateful decision to try to work DXCC with 5 watts or less, and the adventure began.

The only new piece of equipment that I needed for my already-equipped HF station was a QRP transceiver. I purchased the modestly priced MFJ-9020 QRP transceiver, a bare-bones CW rig. It doesn't have a lot of bells and whistles, but it transmits a clean signal and has an excellent superhet receiver that compares with my full-featured HF rig. If you select the MFJ, I strongly recommend the inexpensive built-in CW filter and keyer options. Loaded with these options, you can pick up the MFJ-9020 for around $200. If you really want a full-featured QRP HF transceiver, the Ten-Tec Argonaut II has an excellent reputation.

Re-Creating the Old Excitement

On May 21, 1992, I made my first tentative calls to DX stations. Two calls. Three calls. Nothing. Did my transceiver work? Was my signal getting out? Can 5 watts really work DX? I was getting nervous about QRP.

I powered up my big HF station, and turned down the power to 10 watts. I easily worked UC2AKP in Byelorussia on my first call. I went back to the MFJ running 5 watts and called UC1CWH. Success! He came back to me, and gave me a respectable 559. I operated for four hours that evening and worked 11 DXCC countries, including VK2CWS in Australia. Not bad for 5 watts. I was hooked.

A funny thing happened. I began to experience the excitement of working new ones that I had worked when I was a Novice. Now, with QRP, I re-experienced the excitement of working new countries all over again. I worked a station in Belgium for my 51st country, and was thrilled. Thrilled to work Belgium?

Another funny thing happened. A lot of the DX stations that I worked congratulated me for the contact, and shared their excitement. My log includes some of these entries: "Congrats on QRP." "QRP doing nice job." "VFB copy. FB job."

A lot of DX stations also wanted to know what type of antenna I was using. In 19 years, I can't remember a DX station asking me that question. Today, when operating QRP, many people ask me about my station and antenna.

By September 1, 1992, in less than four months, I had logged contacts on all continents and with 90 DXCC countries. My antenna was a simple ground-mounted Butternut vertical, with a pretty good system of underground radials. My countries included some pretty fair DX, including: Tonga, San Andreas, Kuwait, Fernando de Noronha, Lebanon, Kalingrad, Asiatic Russia, New Caledonia and many others.

On September 2, 1992, I put a Cushcraft A3S triband beam into service, and I have been very pleased with the results. (Actually, I refer to my Cushcraft as "my unfair competitive advantage.") With the tribander, operating at a modest 35 feet, I have been able to break through pretty substantial pile-ups to work rare DX with QRP. In good band conditions, I have received excellent reports, including 579 reports from Central African Republic and Mozambique, running 5 watts.

The beam also brought out a latent competitive spirit in my ham hobby. Remember the feeling you had when you broke through your first pile-up? Well, imagine how I felt when C9RJJ in Mozambique came back to WA3ULH/QRP, knowing that the bigger stations were on the sidelines waiting for their turn behind a 5 watt station!

Photo B. Bill Ingleson ZS6KO with his home-brew QRP transceiver.

By December, I had worked almost 150 DXCC countries and was thinking about a new challenge. I wondered if I could work DXCC using only 1 watt output.

I'm not a highly technical ham, but the MFJ instructions for tuning down the power seemed easy enough. On December 21 I opened up the radio, found the right thing to turn, and made a simple adjustment to reduce power to 1 watt. I sighed a heavy sigh of relief when I put the radio together, and it still worked fine. I must admit that at 1 watt I began to feel a bit like the proverbial Maytag man: "The loneliest guy in town." However, while many stations couldn't hear my meager 1 watt signal, using the beam I was able to work DX when conditions were favorable. I quickly learned to focus on stations coming in solidly at 579 or better. I realized that if I heard a weak station operating at 100 watts, he was unlikely to hear my 1 watt signal.

Collaboration at 1 Watt

On December 24, I made a fateful contact that would lead to one of the most rewarding experiences of my 19-year ham career. I heard a rather weak station calling from South Africa. The signal was very light, so I was about to tune past him, realizing that he wouldn't be able to hear my call. However, the station signed ZS6KO/QRP and, assuming that he was using 5 watts or less, I gave him a call. He was actually running only 1 watt, and we had established a two-way 1 watt QSO at a distance of 8,160 miles. I gave him a 339, and in return I received a whopping 419.

This fateful QSO was the beginning of a new friendship with Bill Ingleson ZS6KO. He and I agreed to meet every night at 0400 UTC to see if we could work with less power, and to find one night with superb conditions to see how low we could go. Since we knew each other's callsigns, we established our own minimum standard: For a contact to be valid, we had to copy a signal report.

I purchased an inexpensive Ten-Tec model 290 attenuator to make it easier to reduce power. The attenuator takes a 5 watt input, and enables you to step between seven power output levels: 5W, 2.5W, 1.0W, 500 mW, 250 mW, 100 mW and 20 mW. I was conservative by using only 4.7 watts input to the attenuator.

The attenuator has been a great resource. But be prepared for one surprise: It attenuates both the transmitter and the receiver. This is not a problem when you are working a loud station who starts out at 599 plus 20 dB, but it becomes a problem when you are working another QRP station. I overcame this problem by using my attenuated MFJ transceiver and my ICOM 735 transceiver as a separate transmitter/receiver combination. ZS6KO and I met every night looking for optimum conditions. Bill had copied me at 100 mW, and I had a solid QSO with his station running at 250 mW.

As our project continued, we developed the habits of checking propagation information on station WWV at 18 minutes after each hour, and listening to the 20 meter beacons on 14,100 kHz. The beacons, which are described in Chapter 2 of the *ARRL Operating Manual*, are an excellent resource to QRPers because they broadcast tones at staged power levels:

Continued on page 8

RF kit review

Lectrokit
401 W. Bogard Rd.
Sandusky OH 44870
Price Class: SP1-BBM (bare PC board with manual)—$12 postpaid
SP1-PC (PC board, manual, all PC board parts)—$29
SP1-Kit (complete kit, including case)—$39
SP1-AT (assembled Spider, 80, 40, or 30)—$59
AF-1 (audio bandpass filter kit)—$6
Shipping (except SP1-BBM)—$4
(Ohio residents please add 6% tax)

Lectrokit SP-1 Spider

by Jim Cates WA6GER

The January 1993 issue of *73* magazine has a cover-feature construction article by Mike Agsten WA8TXT. It is a QRP transceiver—crystal-controlled on BOTH transmit and receive. It is called the "Spider." It can be set up for 80, 40, or 30 meters.

I read the article, mainly because I read everything related to QRP. But my interest was not aroused, remembering all the frustrations of my crystal-controlled Novice days.

Here the matter remained, until Forest N6ZBZ put one of these Spiders on 40 and asked me to listen for him, portable in Phoenix. He was Q5 copy at my QTH in Sacramento, even though his antenna was a dipole only 10 feet off the ground. Good solid QSO.

This grabbed my attention like a . . . well, a spider bite. Monkey see; monkey do. So naturally I had to have one. On 40, of course, my favorite band. I dug out the issue of *73*, checked the old junk box, and got out some catalogs to price a couple of needed parts. Gazooks! These minimum order restrictions! Forget it! And I'm not one for kits; too many irritating past experiences.

But hark! A footnote: Lectrokit offers the board and all surface mounted parts for . . . for only $29? Hey, for 29 bucks I'm starting to like kits.

This one arrived quickly (like return mail?). So, I snipped open the padded envelope to find out what was inside.

What's in the Kit?

To begin with, the instructions are so complete as to make assembly 99% foolproof. Definitely a beginner's project. (Blushingly, I confess I am the reason why the kit is not 100% foolproof. I managed to install Q6 upside-down on the board; not easy with the overlay, which was clearly marked, right in front of me.)

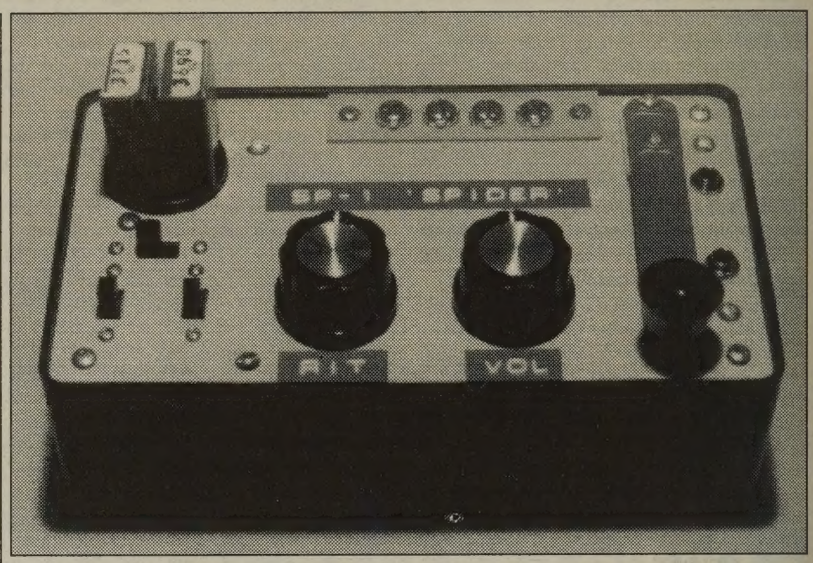
The instructions and the parts are in separate plastic envelopes. And when I say instructions, I mean with CAPITAL LETTERS. Like 16 pages—everything from how to read resistor and capacitor values to a drilling template. Pictorial diagrams, schematic; it's all there. Simply too much to permit a detailed description, so let the table of contents suggest the extent:

1. Fundamentals of component installation
2. PC board assembly
3. Band selection
4. Top panel assembly and wiring
5. Tune-up and operation
6. In case of difficulty
7. Schematic diagram
8. Mechanical drawings
9. Pictorial wiring diagram
10. PC parts overlay

In addition to all the above, there were also step-by-step check-off assembly instructions, making this the most failure-proof kit since Heath.

Is the kit complete? Bet your sweet patootie it is. There's solder included, and even an abrasive pad to scour the circuit board to remove the fingerprints you put on it while turning and eyeballing. All the parts are there. None of this typical product review stuff like: "I phoned XYZ company and they sent the missing parts . . . etc." This kit is complete; I mean, no missing parts. And, they are supplied in bags, permitting bite-sized assembly chunks, letting you follow a logical-sequence assembly.

OK, so now you have it all assembled. How easy is it to tune up? Apple pie. Peak one transformer for RF out, one for maximum received signal strength (loudness). That's it. Period.



Performance

How well does this rig work? Is it practical? Yes, oh yes, yes, yes. In a month of casual operating, around 0800-0900 Pacific time, on my two crystal frequencies, 7120 & 7125, I have worked and confirmed seven states, and I still snag a QSO almost every day.

At night there are the usual foreign broadcast problems, same as you hear from your megabuck rig. But I've worked east to the Great Lakes.

Is 1 watt enough? Believe me, 559 to 599 reports are common. Do you need a CW filter? After all, the receiver bandpass is admittedly a tad broad. Hey, this is a simple rig. Naw, the best filter is the one between your ears. Learn to use it!

I now have three Lectrokit Spiders. And they have put fun back into hamming. I love the challenge: 1 watt, crystal control, 40 meter QRM and QRN. Honestly, it isn't that big a deal, but it's entirely practical. And, if 40 isn't your cup of tea, put yours on 80 or 30. You'll love it, and that's a promise. RF

My Recent Experiences with QRP

Continued from page 7

100W, 10W, 1W, and 100 mW. Conveniently, there is a beacon in South Africa for me to monitor, and a beacon on the East Coast for Bill.

Our goal was to work each other at 20 mW, an excruciating 37 dB drop from full power at 100 watts, and a 24 dB drop from 5 watts. Working at 20 mW seemed like working with a 5 watt input into a coat-hanger antenna. Night after night, nothing came through at 20 mW. Not a peep. In the meantime, I did manage to work stations freestyle in Vancouver, Seattle, and San Francisco at 20 mW. These contacts put me over the 100,000 mile per watt mark, but the signal was not audible in Pretoria.

However, on January 14 our patience was rewarded with superb band conditions. Solar Flux was 141, and the A-index of the geomagnetic field was a relatively quiet 08. These represented excellent conditions at this stage of the sunspot cycle. I easily heard Bill's signal running at 100 mW, and band conditions were still picking up.

I dropped my power to 20 mW, while Bill was operating QRO at 100 watts. At full power Bill was operating at 599 plus 20 dB. But I didn't want to send him a 599 report because I wanted to make absolutely certain that he could hear my 20 mW signal. I threw him a curve ball, and gave him a report of 579. He copied the report: "R R R QSL 579 FB ROB CONGRATS."

I went QRO and gave Bill a chance to get through at 20 mW. The band was quiet. I put my headphones on and listened for his signal. His signal was extremely light. I half heard it and half felt it as the signal faded above and below the noise level. I asked him to repeat the report and as he strengthened above the noise level, I clearly heard my 589 report. He threw me a curve ball, too! We had achieved a respectable 408,000 miles per watt.

Band conditions were excellent, and we decided to take advantage of propagation by establishing a two-way QSO at ultra low power. We dropped to 250 mW and had "armchair" copy. At least it seemed like easy copy after working him at 20 mW. I gave Bill a 429, and I received a 329 in return. While operating at 250 mW we agreed to drop power to 100 mW, and we enjoyed a nice two-way QSO without too much difficulty. On this particular band opening, 100 mW seemed like "armchair copy."

Upon reflection, I realize that I am not the first amateur to work 150 countries with 5 watts, and that working 408,000 miles per watt is by no means a world record. I am not a radio pioneer. But these QRP experiences have re-energized my enjoyment of amateur radio, and have opened a new facet to my enjoyment of our wonderfully diverse hobby. It has given me the opportunity to set and achieve new goals, to learn new operating techniques, and to make new friends. It's been a lot of fun.

Bill Ingleson and I have talked about building "monster fixed beams" pointed at one another, and shooting for two-way contact with even less power, during the next solar sunspot peak.

I'm still actively chasing new countries on my large HF station, and I am inching forward on my goal of reaching the DXCC honor roll (286 countries worked, and at my present rate, it will only take another 19 years to make the honor roll). In the meantime, QRP has done a great job filling in the spaces between DXpeditions. Lately, I've been having lots of fun with solar power, and am now working DX with a solar-powered battery.

Maybe its time for you to give QRP a try and get in on the fun. In the meantime, do me a favor. Whenever you hear a station signing "/QRP," give him a call! RF

letters

Continued from page 5

accent hard to decipher is no problem with CW . . . there *are* no accents. Even though I took French in school many years ago I only really speak English fluently. Fortunately, most SSB stations speak in English and that helps me, but the accents can quite often make the conversation very hard to understand. CW has distinctive "fists," but unless your QSO is with someone who runs their words together (pet peeve), it is very easy to understand.

I don't have a bumper sticker on my car that says "I Love CW," but I really hope that the fun I have on CW is not denied new amateurs who will be licensed in the years to come.

Vern Snyder, Duluth GA I enjoy receiving *Radio Fun* every month—it is a great magazine for new hams.

I will be taking the Novice test next month and I would like to ask you some questions. I don't have a lot of money to invest in equipment. Some hams in the area tell me that I should purchase a transceiver such as a Yaesu or Kenwood. I can swing an SB-102, HW-101, or a Heathkit SB-401 and 303 combination. Since Heath is now out of business, would you advise me to purchase one of the above? I would rather use a rig that is not a cold machine, one that I can get involved with rag-chewing and code on 15 meters. Any advice you may give me will be deeply appreciated.

Vern—Any of the tube rigs of that vintage will make a neat first rig. I had a used HW-101 for years. As long as you can test before you buy, you'll get years of fun out of those old rigs . . . David N1GPH

Rege Dvorsky WA3LKT, Grasonville MD Lately I have been seeing bulletins on packet stating that the FCC has relaxed rules as to what type of conversations can take place over amateur radio. I find it very disappointing to see that hams will be ordering pizza and making doctor's appointments on our frequencies. I have been a ham since 1968 and active most of those years and find that the more the rules are relaxed, the more the bands seem to experience a degradation in the quality of operating.

It seems the trend of new radio rules is to ease up on the requirements of radio operators and to let anything go. This, to me, does not seem to be for the best of the hobby. At some point in time there have to be some rules and some discipline. We seem to be leaning more and more towards what could be a business-band radio (ordering pizzas, making doctor's appointments, calling into work sick). I did not realize that this was the intent of our bands. It scares me that the trend is to relax the restrictions so much that gradually there will be no difference between the ham bands and the business bands or citizens band or marine bands. A little discipline and making a few requirements for the privilege of operating does not seem too much to ask. Giving your children anything they want does not always produce the best child.

I would hate to see someone going to take a test for their ham license so that they can call into work or or make business and personal phone calls for the price of a repeater membership fee. This is not what ham radio is all about. I can see being a public service, but this is now a little extreme as far as I can see. The more ham radio frequencies become intertwined with businesses, it seems inevitable that we are absorbed or taken over. At what point do you separate the two and at what point do you draw the line? We are a hobby . . . not a necessity to carry on everyday business. That is what keeps us separate and keeps us the special entity we are. I hope the line is drawn somewhere.

Rege—I've been hamming since 1938. For years we ordered pizza and made restaurant reservations with no one being hurt. But you can carry any privilege to an extreme and spoil it. The FCC has merely restored things, so stop with the commercial and CB baloney . . . Wayne RF

RF vintage review

The Hallicrafters SX-140K

by Donald A. Smith W3UZN and Kent A. Mitchell W3WTO

Are you in the market for a receiver in the $100 to $125 price range, but undecided whether to purchase a commercially-built set or one in kit form? Why not combine the advantages of both and consider the Hallicrafters SX-140K? This is the companion receiver for the HT-40K transmitter kit as described in the May 1962 issue of *73 Magazine*. A ham-band-only receiver, the SX-140K covers 80 through 6 meters.

Lest you have misgivings concerning constructing a receiver because of the usual associated task of RF and oscillator stage alignments, let us hasten to mention that the SX-140K receiver kit is supplied with a completely aligned and prewired bandswitch assembly.

The receiver incorporates a pentode RF amplifier, one half of a 6AZ8, with a manual RF gain control in series with its cathode. A 6U8A is used as the local oscillator-mixer stage, its output fed to a 6BA6 IF amplifier. The oscillator frequency is varied by a main tuning capacitor. No fine-tuning control is necessary, due to the 25-to-1 tuning ratio of the main tuning, which is very adequate for the 6-inch-per-band of slide-rule dial provided. The selectivity-BFO control in the suppressor grid of the IF stage is actually a regeneration control and effectively varies the selectivity of the stage from approximately 8 kHz to 2 kHz. Advancing the control until the stage breaks into oscillation provides a beat note for CW and SSB reception. Operation and adjustment of this control is both simple and effective.

The IF output signal is coupled to a 6T8A, which not only functions as the detector and first audio amplification stages but performs as noise limiter and AVC control stages as well. Noise limiting is by diode action and AVC by the conventional feedback method.

The tetrode section of a 6AW8A is the audio output stage and is connected through an output transformer to a pair of terminals on the rear chassis apron and to a headphone jack on the front panel. Though there is no built-in speaker, there is enough cabinet space for a 3" x 5" speaker to be mounted on the top of the receiver cabinet by the more enterprising builder.

The remaining triode section of the 6AW8A is incorporated as the S-meter amplifier. It must really amplify, too, as the S-meter calibration goes up to 90 dB above S9! The meter is disabled in the CW-SSB mode to prevent the needle from pegging and otherwise flopping around unnecessarily.

An unusual, useful, and welcome feature, especially for a receiver in this price category, is the inclusion of a crystal-controlled calibration oscillator. With the oscillator (the triode section of the 6AZ8) operating at the crystal frequency of 3.5 MHz, fundamental and even harmonic signals are injected into the local oscillator to produce band-edge calibration points at 3.5, 7.0, 14.0, 21.0, and 28.0 MHz. For 6 meters, an odd harmonic must be used, and is heard at 52.5 MHz. The Calibration Reset control on the front panel is a variable capacitor paralleled with the Main Tuning variable.

The power supply is transformer-operated, thereby safely isolating the chassis from the AC line, and has silicon diode rectifiers.

Provisions are made for transmitter control and antenna changeover hook-ups via auxiliary contacts on the function switch. When placed in the standby position, two pairs of terminals on the rear chassis apron are shorted, providing switch action.

Two manuals are furnished with the SX-140K; one is the assembly manual and may be discarded upon completion of the kit, and the other is an operation and service manual. Keeping these two items under separate cover is a good idea . . . we'd like to see some other kit manufacturers do the same.

All said and done, the authors are very impressed with this little receiver, both in design and performance. Sensitivity and especially selectivity appear to be well above average for receivers of this type. In short, it would be hard to find a comparable receiver at this price, particularly with 6 meter band coverage to boot. RF

Reprinted from the November 1963 issue of 73 Amateur Radio.

SX-140K Specifications

Frequency Coverage	80, 40, 20, 15, 10, 6 meters (ham bands only)
Tube Complement	6AZ8 RF amplifier/calibration osc. 6USA local oscillator/mixer 6BA6 IF amplifier 6T8A detector, ANL, 1st audio 6AW8A audio output/S-meter amplifier
Controls	Main tuning, function (Off, Standby, AM, CW-SSB), audio gain, band selector (6 position), RF gain, selectivity/BFO, ANL (on-off), calibrator (on-off), calibration reset, antenna trim
Antenna impedance	50-75 ohms
Audio output impedance	3.2 ohms
Power supply	Transformer operated, silicon diode rectifiers in a doubler circuit
Power requirements	117 VAC, 50-60 cycles @ 47 watts
Dimensions	13-3/8" wide, 8-1/4" deep, 7-3/16" high

RF vintage review

The National 200

by Jim Fisk W1DTY

When National came out with their model 200 transceiver at a lower cost than any other five-band transceiver on the market, I just couldn't believe that it would perform as well as the more expensive models. But, after using it for several weeks chasing DX, I find that they have done a superb job and it performs right along with the best of them. The sensitivity is fine, the selectivity afforded by the steep-sided crystal filter is excellent, and the audio reports, if I am to believe the fellows on the other end, have all been good. Reports of "tremendous audio quality," "really sounds good," and "very clean and crisp," have been normal during the time I have had the 200 on the air.

In the National 200, the final amplifier pi network and the driver tuning circuits also double as the RF circuits for the receiver. The VFO and carrier oscillator are common to both transmitter and receiver, and the first IF stage in the receiver also serves as a low-level amplifier in the transmitter. The use of common crystal filter and RF input components results in a sensitive and relatively image-free receiver and highly efficient SSB transmitter. Sideband switching is automatic with lower sideband on 40 and 80, and upper sideband on 20, 15 and 10 meters.

The front end of the receiver starts out with a 6BZ6 RF amplifier, followed by a 12BE6 mixer, the 5.2 MHz crystal filter, two 12BA6 IF stages at 5.2 MHz, a 12AX7 AM detector, product detector and first audio and, finally, a 6AQ5 audio power stage. The AGC voltage is derived from the second IF stage, run through a semiconductor diode voltage doubler to get it up to the proper level, and then applied to the first IF and RF stages.

The 8.7 to 9.3 MHz high frequency mixing signal from the VFO is premixed in a 6GH8 stage with a crystal-controlled signal on 40, 15 and 10 meters so only one stage of conversion is required in the receiver itself. On 80 and 20, the VFO signal is mixed directly with the incoming RF signal to obtain the 5.2 MHz IF. This procedure somewhat simplifies things and eliminates many problems with spurious responses and birdies that might appear in the receiver tuning ranges.

The tube lineup in the transmitter begins with a 6GH8 microphone preamp, then to a 6GH8 speech amplifier and solid-state balanced modulator where it is mixed with the 5.203 MHz signal from the 12BA6 carrier oscillator. The sidebands at the output of the balanced modulator are fed into a 12BA6 transmitting IF amplifier and then into the crystal lattice filter. The sideband output of the filter goes through another 12BA6 for further amplification, then to a 6JF6 transmitting mixer where it is mixed with the VFO and carrier oscillator signal available from the 6GH8 premixer. A 6GK6 driver and two 6JB6s in the final complete the layout of the 200 watt SSB transmitter. The excellent sideband qualities are a direct result of the very steep-sided crystal lattice filter and the use of double-tuned circuits in the transmitting IF stages.

The National 200 incorporates a very sensitive automatic level control (ALC) circuit in the final. This circuit makes use of the fact that when the control grids of the power amplifier tubes are overdriven on voice peaks, the resultant positive voltage on the grid causes grid current to flow. This current in turn causes a negative voltage change in the bias network; the resulting audio signal on the bias circuit is capacitively coupled to a voltage doubler for rectification and fed back to the first IF stage to control the audio gain. When the final amplifier is overdriven, the gain of the first IF stage is reduced, resulting in less driving signal at the final. The ALC voltage cannot discharge through the voltage doubling circuit, so the resultant action is a fast attack and slow release. The circuit is designed to provide an automatic leveling control for 10 dB variations in the audio signal. This makes the setting of the microphone gain quite noncritical and changes in the voice level or large background noises are controlled without distortion. When the National 200 is used with a linear amplifier, there is provision for using an external ALC signal from the linear to control the audio stages of the 200.

The variable frequency oscillator used in the National 200 uses a straightforward grounded-cathode Hartley oscillator. To minimize the effects of warm-up drift and to insure long-term frequency stability, all the frequency determining components in the VFO have been carefully selected. To further insure the frequency stability of the unit, the output is taken from the screen grid of the oscillator tube. After a 30-minute warm-up, the stability seems to be very good. Variations in line voltage have only a very slight effect, not enough to require retuning the station you're working. After an initial five-minute warm-up, the unit drifted about 1000 Hz over the next 25 minutes; after this 30-minute period the drift was insignificant.

In addition to operating on single sideband, the 200 may be used on CW or even AM. A simple adjustment on the back sets the carrier insertion for CW and AM. Once this control has been set for one band it may be left alone. The mode switch on the front panel automatically suppresses this control for SSB operation but permits full carrier insertion on AM and CW. Actually, when this pot is switched into the circuit in the AM and CW modes, it is used to upset the balance of the diode modulator. In addition, for AM or CW, the bias is removed from the 12BA6 transmitting IF stage, providing full carrier insertion of 60 to 300 mA.

This transceiver is designed to load into a 40 to 60 ohm unbalanced load. When the load is within these limits, it loads up very nicely and quite quickly with the three controls required. In this respect, the National 200 is similar to many other transceivers on the market—peak the exciter, load the power amplifier and tune for a dip. Since the receiver uses the transmitter-tuned circuits in its input, when the transmitter is tuned up, the receiver is also matched to the transmission line. In the transmit mode, the meter reads final amplifier cathode current; in the receive mode it functions as an S-meter.

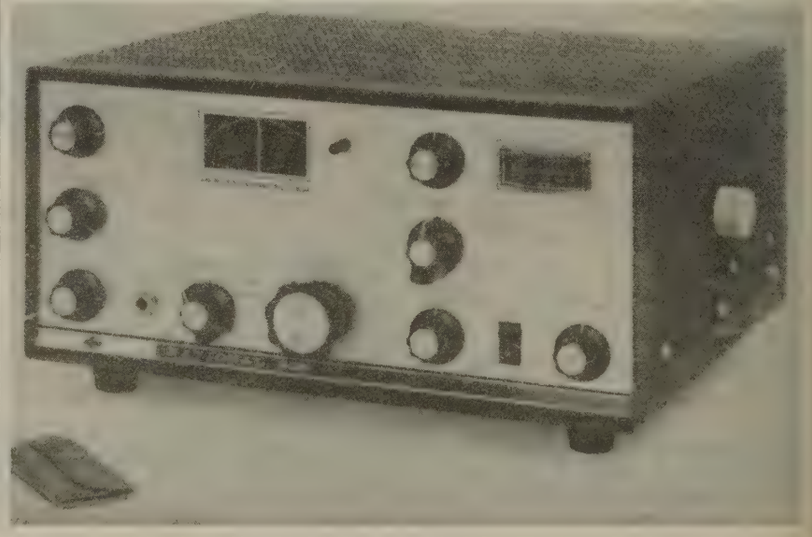
The National 200 may be used either in a fixed station from the 115 volt line with the AC-200 power supply, or mobile with a power supply that furnishes all the necessary voltages. To aid the mobileers, National has thoughtfully included a mobile mount in the package with the 200. This mount is a U-shaped bracket that may be clamped under the dash of your car; the transceiver fits into the bracket and is held in place with a couple of large knurled thumb nuts. To remove the unit for fixed station operation, all you have to do is disconnect the antenna and power plug and remove the thumb nuts.

All in all, the National 200 transceiver seems like a very good investment for those of you who are shopping around for a good all-band transceiver. It is compact, lightweight, easy to use and, best of all, it works well. It's not often that you get all these attributes in one package! RF

Reprinted from the February 1967 issue of 73 Magazine.

National 200 Specifications

Frequency Coverage	3.5-4.1 MHz, 7.0-7.5 Mhz, 13.9-14.5 MHz, 21.0-21.6 MHz, 28.5-29.1 MHz with crystals provided.
Types of Emission	SSB (upper sideband on 20, 15 and 10 meters; lower sideband on 80 and 40 meters), AM, CW.
Power Input	200 watts PEP SSB, 200 watts CW, 100 watts AM.
Power Output (Nominal)	120 watts PEP SSB, 120 watts CW, 30 watts AM.
SSB Generation	Crystal lattice filter; 6-50 dB shape factor 2.2:1. Bandwidth 2.8 kHz at 6 dB. Carrier suppression -50 dB; unwanted sideband suppression -40 dB; 3rd order distortion products suppressed -30 dB at full output.
Receiver Sensitivity	0.5 µV for 10 dB S/N in SSB mode.
Features	Full AGC and S-meter on receive, push-to-talk or manual operation on transmit with ALC for SSB. Automatic carrier insertion for AM or CW. Product detector for SSB and CW, AM detector for AM on receive. Grid block keying on CW.
Tuning dial	45:1 tuning ratio. Dial calibrated at 5 kHz points on all bands.
Tubes and semi-conductors	16 tubes, 10 semiconductors, parallel 6JB6s in the power amplifier.
Accessories	AC-200 power supply for either 117 or 234 VAC, 50/60 Hz; XCU-27 100 kHz crystal calibrator.
Size and weight	6-3/16" x 13-3/8" x 11"; 15 pounds.
Power requirements	700 volts DC at 300 mA, 280 volts DC at 200 mA, -80 volts DC at 10 mA, 12.6 volts at 5 A.
Price	$359



Is It a Cell or a Battery?

by Robert C. Green W3RZD

How many times have you walked into a store and asked for a D-size battery? When you left the store did you have what you wanted? Did you have a D battery or did you have a D cell?

"Aren't they the same?" you ask.

Well, no and yes. No, because a cell is a single unit and a battery is composed of two or more cells. Yes, because a cell is now commonly referred to as a battery.

History

Somebody has to be blamed for starting this controversy, so let's place it on Count Alessandro Volta, an Italian physicist. One day in 1789, the good Count poured acetic acid into a jar and placed a zinc rod and a copper rod in the acid, and invented the electric cell. The acetic acid formed an electrolyte, and the rods the positive and negative electrodes: the great granddaddy of all cells in use today.

The Voltaic cell remained a laboratory toy until Samuel F.B. Morse put it to practical use in 1837. In that year Morse was granted a patent for the telegraph. The cell stayed in its basic form until 1868, when it was improved by George Leclanch into a more practical unit. Since a liquid was used for the electrolytes, they were called wet cells. Another 20 years would pass before a cell was developed that used a paste or semi-dry electrolyte, and became the forerunner of the present-day dry cell.

The Count can be thanked for another thing; the term volt was derived from his name.

Types of Cells

Before we go any further, remember that current and voltage are different, and the capacity of a cell is the amount of current it can supply over time.

A wet cell is classified as a secondary cell, and a secondary cell can be recharged. Wet cells are still in use today, the most common form being the automobile battery. Automobile batteries are also known as lead-acid batteries, using electrodes composed of coated lead plates in a mixture of sulfuric acid and water. A relatively new type of wet cell on the market uses a gel as the electrolyte, and is commonly called a gel cell. A fully-charged wet cell will have an output of 2.25 volts.

A secondary cell is often referred to as a storage cell because of its ability to store a charge, but not indefinitely. If a wet cell is discharged below 40% of its rated capacity it can be damaged permanently. For many years wet cells of all sizes were packaged only in glass or earthenware jars. With the advent of the automobile battery, hard rubber was used for the container. Wet cells are heavy, and should be handled carefully due to the possibility of being dropped and breaking. Gel cells are usually packaged in non-spillable plastic containers. WARNING: WET CELLS CONTAIN CAUSTIC ACID AND CAN CAUSE SEVERE BURNS.

A dry cell is a primary cell, and a primary cell cannot be recharged. There are eight types of dry cells. These types and their output voltage are: carbon-zinc, 1.5V; zinc-chloride, 1.5V; alkaline, 1.5V; nickel-cadmium, 1.2V; lithium, 3.0V; silver, 1.5V; mercury, 1.4V; and zinc-air, 1.45V.

We will talk about only the first four types because of their use in radio equipment. The latter four are of the button type used in watches, calculators, hearing aids, pagers, etc.

Popular Disposable Types

Carbon zinc is the cheapest to manufacture and has the shortest life of the first four. A zinc chloride cell has half again the capacity of a carbon zinc, and it is worth the few extra pennies in the purchase price. An alkaline cell will outlast a carbon zinc cell of the same size, when the same current is drawn, seven or eight to one. When considering the capacity of any of these cells, a D cell has approximately six times that of an AA cell.

Temperature plays an important part in the life of any cell. The output voltage will drop off as the temperature increases or decreases. New carbon zinc, zinc chloride, and alkaline cells can be stored at temperatures as low as -40 degrees F, but at this temperature the output capacity is near zero. Carbon zinc cells will not perform very well at either low or high temperature. The zinc chloride cell is slightly more efficient at low and high temperatures. An alkaline cell is superior to both the carbon zinc and zinc chloride at low temperatures, but at high temperatures not much better than the carbon zinc.

All three of these cells decrease in output voltage every time they are used. How fast they drop depends on age, temperature, and the current drawn from them. When the output drops to 0.9 volt, the cells have reached the end of their useful life and should be discarded.

NiCd Rechargeables

Nickel-cadmium cells, commonly referred to as NiCds, look like dry cells, but are secondary cells. However, the NiCd is not a wet cell; the electrolyte is neither a liquid nor a gel.

When fully charged, a NiCd cell will have an output of 1.2 volts. In use, the output voltage will remain practically constant until its ability to supply current is exhausted, at which point the voltage drops rapidly. When the output drops to 1.0 volt the cell should be recharged. There are two types of rechargers for cells; constant current and constant voltage. *Constant current* types should be used for NiCds, and *constant voltage* used for wet cells.

Despite the advantage that they can be recharged, NiCd cells have several disadvantages. One is that they can develop a memory as to their state of charge. Basically, if a fully-charged NiCd is placed in service and used to the same state of discharge each time before being recharged, it will "remember" the lower condition and will not operate below that point. If this is happening, the cell will appear to have a short life cycle between charges. Before recharging it should be discharged fully to erase any memory.

A second disadvantage is that occasionally NiCd cells will reverse polarity: The negative becomes positive and the positive becomes negative. This usually only happens to a cell that is part of a battery pack that was placed in storage in a semi-discharged state. Because cells are like people and no two are alike, the internal resistance of one cell will change more rapidly than the other cells. When the pack is recharged the bad cell will have less charge than its neighbors, and the good cells discharge through it, changing the polarity. When NiCds are placed in storage they should be in a discharged condition. Cell manufacturers are aware of this and ship cells uncharged.

Another disadvantage is that sometimes a cell will develop an internal short circuit. Usually this can be corrected by "zapping" the cell momentarily with a slightly higher voltage. Some chargers have a built-in "zapper."

A NiCd cell has an operating temperature range from just below 0 degrees F to a little more than 100 degrees F.

The Right Cell for the Job

A relatively new cell on the market is the rechargeable nickel-metal hybrid, which uses hydrogen and another element as the electrolyte. Its capacity is greater than the NiCd but less than the alkaline, considering cells of the same size. The lithium cell is also undergoing changes and being developed into a rechargeable cell. When it becomes marketable it may obsolete the NiCd: It has twice the voltage, a higher capacity for its size, better charging characteristics, and a lighter weight.

Let's see what service the four types of cells will handle best. Carbon zinc: can be used in flashlights (if not subject to the low and high temperatures found in automobiles), low-drain portable radios and some toys. Zinc chloride: battery driven clocks, portable radios with higher power amplifiers, flashlights if not subject to high temperatures. Alkaline: clocks, toys with high current drain, portable stereo radios, tape recorders that are subject to heavy usage, photoflash cameras, walkie-talkies, two-way radios, flashlights kept in automobiles. In general, the alkaline is a good all-around cell that can be used for just about any purpose. It also has a shelf life of several years, without much loss of capacity. However, in weight it is the heaviest of all the cells. Nickel-cadmium: another good general purpose cell. It generally can be used in place of an alkaline, but has less capacity, and does not have the temperature range of an alkaline. The big plus for a NiCd is it can be recharged 1,000 times, if done properly.

NiCd Don'ts

There are three DON'TS for NiCds. First, don't solder to the terminals; use a cell holder. Second, don't carry a fully-charged cell in a pocket or case if there is a possibility of it being shorted. The short could generate very high heat and possibly cause a fire; always place a strip of electrical tape over the positive terminal. Third, don't throw old cells in a fire as there is the danger of an explosion.

It is a good idea to place tape over the positive terminal of any cell not stored in a package.

Cells can be connected in series or parallel. When cells are connected in series the output voltage is the sum of the individual cell voltages. However, the maximum current that can be drawn is no greater than that of a single cell. When cells are connected in parallel the maximum current that can be drawn is that of a single cell multiplied by the number of cells, but the voltage output is that of a single cell. Only cells that are *alike* should be used in a series or parallel circuit. This means that all the cells should be the same type, the same size, and preferably new. If this is the case they will all have the same rate of discharge and there will be less chance of one cell causing trouble.

An automobile battery is a good example of a series-parallel connected battery. It is made up of a number of identical wet cells connected in parallel, which are connected in series to another group of parallel cells that are identical to the first group. This continues until there are enough cells for the voltage and current ratings desired. Another example would be a 9 volt battery used in portable radios. It is composed of six identical 1-1/2 volt dry cells connected in series. Cells can be formed into batteries of any electrical size: high voltage and low current, or low voltage and high current, or even high voltage at high current capacity.

When purchasing cells buy them when they are on sale, and store them in the refrigerator proper, NOT in the freezer compartment. When a cell is needed, allow it to warm to room temperature before placing it in service.

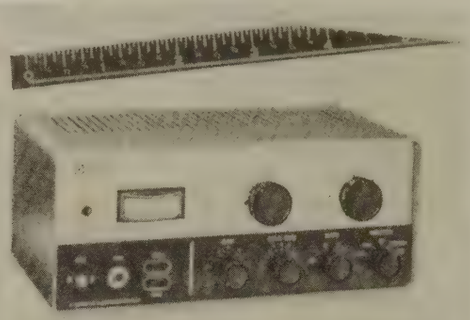
When any cells are purchased always pick those that show the longest expiration date. If there isn't an expiration date on the package don't buy them, except in an emergency. Don't buy cells at any store that might have a slow turnover in battery sales. One way you can check on the sales turnover is by looking for dust on the cells or packages. RF

RF vintage review

Band (Meters)	Frequency of Crystal or VFO (MHz)	Transmitter Freq. Range (MHz)
	Table 1.	
80	3.5 to 4.0	3.5 to 4.0
40	7.0 to 7.3	7.0 to 7.3
20	7.0 to 7.175	14.0 to 14.35
15	7.0 to 7.150	21.0 to 21.45
10	7.0 to 7.425	28.0 to 29.7
6	8.334 to 9.0	50.0 to 54.0

The Knight T-60 Transmitter

by Roy E. Pafenberg W4WKM



A 60 watt AM and CW transmitter with full 80 through 6 meter amateur band coverage for less than $50? It's hard to believe but this is what Allied Radio Corporation has accomplished in their new transmitter kit. The Knight T-60 is a completely self-contained, neat little package that puts out an amazing signal for its size.

A quick check of the specifications will verify that this easy-to-assemble kit is a real bargain on today's amateur equipment market. How does this Knight-Kit provide so many features at the price of $49.95? Part of the reason is, of course, that it is a kit; you supply the majority of the labor. That is, if you call the interesting, easy assembly of the transmitter labor. The design concepts that provide high performance at low cost include a silicon rectifier power supply, use of a mass-produced, high efficiency TV sweep tube in the output stage and a highly effective, controlled carrier screen modulation system that provides good quality speech with plenty of punch. This audio system allows the final to loaf along at about a quarter normal power input and still approach the CW input of 60 watts on voice peaks.

These same features make compact construction possible and this little transmitter is no larger than a man-size shoe box. The gray wrinkle finished, rugged steel cabinet and the two-tone panel provide a very attractive and practical housing. Despite the compact construction, assembly is easy.

The 218 separate assembly steps are arranged in easy-to-understand, check-off order in the large 8-1/2" x 11", well-printed instruction manual. This 32-page booklet contains 19 clear illustrations in addition to the schematic diagram and complete illustrated parts breakdown. As a further construction aid, six of the major assembly illustrations are duplicated in 15" x 20" wall chart form. With all of this assistance, it is indeed difficult to goof.

Good quality parts are used throughout the transmitter and packaging of the parts is geared to convenient assembly. Resistors are card-mounted and are marked for ready selection. Other small parts are supplied in transparent plastic bags for easy identification. These features, along with the illustrated parts breakdown, detailed drawings and self-checking instructions, make for rapid assembly by even the most inexperienced individual.

The schematic diagram of the T-60 transmitter is shown in Figure 1. The circuit consists of a 6HF8 triode section (V1A) operating as a Pierce crystal oscillator or as a VFO amplifier. The pentode section of the 6HF8 (V1B) is used as a buffer amplifier or frequency multiplier, depending on the band in use. An adjustable pi network tuned circuit is used to couple the buffer-multiplier stage to the grid of the 6DQ6B (V4) power amplifier stage. The plate of the 6DQ6B is shunt-fed and a pi network used to provide the proper match between the high impedance plate circuit and the antenna. Antennas with impedances ranging between 40 and 600 ohms can be matched with this network. Table 1 charts the frequency coverage of the transmitter, along with the recommended crystal or external VFO frequencies for each band.

The metering circuit of the T-60 follows the trend established in several recent transmitters. A crystal diode, CR1, is used to rectify a portion of the RF present at the output of the antenna network. The filtered output of the diode is applied to the meter and a shunt resistor may be switched in to avoid off-scale deflection of the meter when feeding high impedance loads. The DRIVE TUNE, PLATE TUNE and LOAD controls are all adjusted for maximum meter deflection with the FUNCTION switch in the tune position. The switch is then thrown to the CW position and the controls peaked for maximum output. While this may appear to be a quick and dirty method of metering a three-stage transmitter, it really works well and permits easy, accurate tuning by inexperienced operators.

The cathode circuits of the oscillator, buffer-multiplier and power amplifier stages are connected to the key jack. When the key is closed, these points are at ground potential. In the key-up condition, a 2.2k ohm resistor is inserted in the circuit. The cathode current of the 6DQ6B develops a bias voltage across the resistor which is sufficient to reduce the 6DQ6 plate and screen currents to a safe value and completely cut off the oscillator and buffer stages. This design feature reduces the voltage across the open key to a safe value and provides excellent keying characteristics. There is one disadvantage to this keying circuit: If an external VFO is used, it must run continuously and keying must be accomplished in the transmitter.

In the AM mode, a cascaded 12AX7 (V2) is used as a speech amplifier which drives the first section of the 6DR7 (V3) modulator stage. This section of the modulator is operated at zero bias and grid rectification of the applied audio signal occurs. This increase in bias causes the plate voltage to rise, varying with the modulating signal. The grid of the second section is connected to the plate of the input section and this positive voltage rise increases the cathode current, and thus the voltage, of the output stage. A portion of this voltage is applied to the 6DQ6B screen. This voltage rises with modulation and varies at an audio rate, modulating the screen of the RF output amplifier and increasing the average DC potential of the screen. In the TUNE position of the FUNCTION switch, reduced screen voltage is applied to the 6DQ6B and out-of-resonance plate current is reduced to a safe value.

The power supply is conventional and consists of a power transformer with the plate and filament windings. A full-wave voltage doubler circuit, using silicon rectifiers and an RC filter, develops 440 volts DC for the plate and screen circuits.

The completed transmitter was bench-tested, using an M.C. Jones Type 625 wattmeter as a 50 ohm load with the internal indicator used to measure power output on 6 meters. Since the directional coupler used in this instrument is frequency sensitive, a Hewlett-Packard 41 OB VTVM was used to measure the voltage across the load and power output computed for the other bands. PA stage input power was metered and, with the transmitter tuned for maximum output in accordance with the instructions, found to range between 63 watts on 80 meters and 76 watts on 10 meters. Using *active* crystals, CW power output ranged between 40 watts on 80 meters and 26 watts on 10 meters. Efficiency on 6 meters is of course greatly reduced since the PA is operating as a doubler. Measured power output on 6 meters was 13 watts with 80 watts input. It must be emphasized that these measurements were made by tuning in accordance with the instructions, letting the operating conditions fall as they would.

A 1,000-cycle tone was applied to the microphone input and a scope connected to mon-

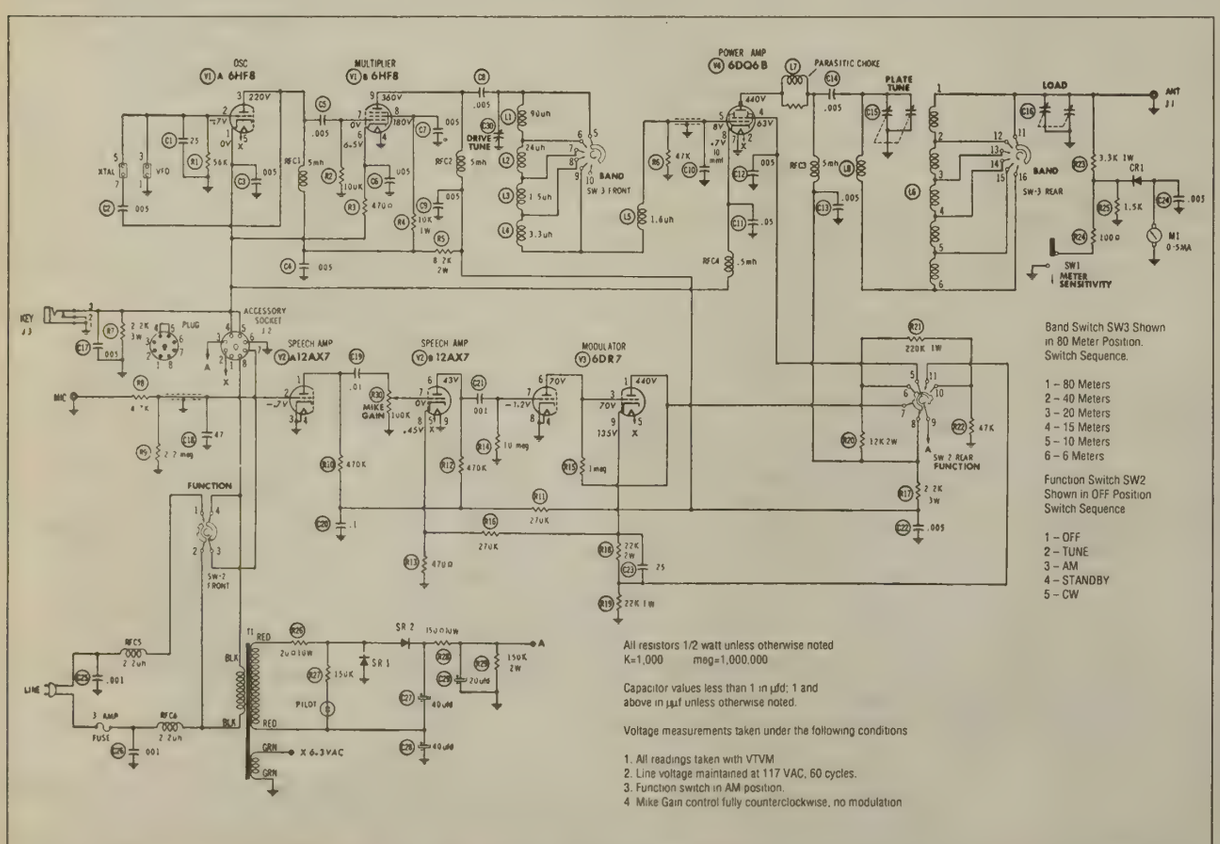


Figure 1. Schematic diagram of the T-60 transmitter.

A Filter to Eliminate Alternator Whine

An easy method of quieting your mobile rig.

by Bruce Hammond AA8HS

Alternators and other electrical devices in today's cars produce pulses of changing frequency that can be transferred along the vehicle's electrical system. This creates what is commonly called "alternator whine." It changes pitch with the speed of the engine. This particularly affects digital radios and can become worse with high power draws while transmitting. The usual solution has been to power the HT or mobile rig directly from the car battery. This method may be inconvenient, impossible, or may not eliminate the problem at all! The pulses can be transmitted directly through the battery, depending on how devices are wired into the electrical system.

Since my car's digital AM-FM stereo radio had no alternator whine and is connected to the fuse box, I knew that filtering was a solution to severe "whine" in an HT or mobile rig. The filter shown is very effective and works to a 10 amp current drain. It is extremely simple to build and costs about $21 with new parts, although junk box devices could also be used effectively. Larger capacitors and chokes can be used for higher current. It essentially duplicates the type of filtering used in high power stereo equipment where a flat DC voltage is needed with extremely little AC component.

Capacitors C1, C2 and C3 on the input side filter AC signals of low, medium and high frequencies. The Radio Shack 270-051 noise filter blocks AC components from the positive or negative side. I don't know the exact contents of the Radio Shack filter unit but resistance measurements show 0.3 ohms between each of the red and black leads, which is consistent with reasonably large chokes. There may also be some parallel capacitance. Connecting the two black leads together would eliminate the minimal voltage drop across the negative side choke but this does not appreciably affect performance. C4, C5 and C6 remove any residual AC signal. C4 is particularly large and helps to eliminate the effects of transient changes in the electrical system voltage. It's a good idea to tap into the fuse box at an accessory outlet or cigar lighter since these points are more likely to be independent of the ignition switch. The radio should be grounded as directly as possible to the car body, as the mobile antenna should be. For temporary operation, a cigar lighter plug alone can be used for both positive and negative leads.

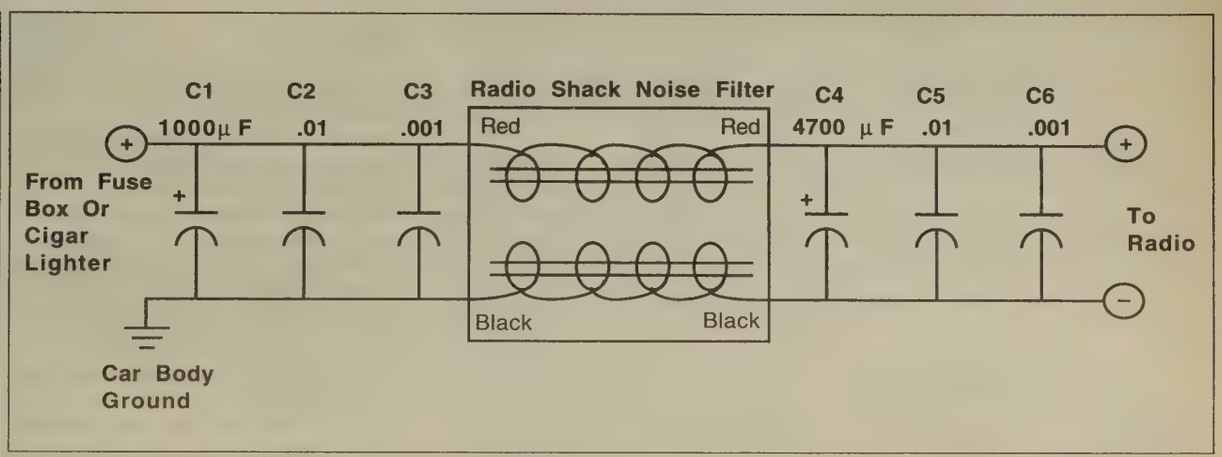


Figure 1. A filter to eliminate alternator whine. All capacitors are 35 volts or more. C1 and C4 are electrolytics.

Be sure to select the right size fuse for the radio that you plan to use. The filter can be built in any enclosure that you like. After soldering all leads together, I insulated the exposed wire leads with electrical tape and wrapped the entire assembly in thick cloth, placing it under the car seat. Good luck! RF

itor the RF envelope. The gain control was advanced to the point where distortion was apparent. This occurred at between 90% and 100% modulation, depending on tuning and loading. Measured *peak* power output was roughly equal to the CW output for identical tuning and loading conditions.

On the air tests produced good results. No attempts were made to establish any DX records, the objective being to obtain critical reports on signal quality. Comments on the controlled carrier modulation system were typical. "Your audio quality is good, OM, but your carrier seems to be going up and down." Those operators familiar with controlled carrier AM signals gave good reports. Constructive, "on the air" help in finding the proper setting of the audio gain control was difficult to obtain. The proper point, verified by the scope, is just below the setting where audio distortion becomes noticeable.

There are very few complaints with the transmitter. The comments on the metering system cannot be taken too seriously since the system works and works well. The reduced output on 6 meters is more serious. However, since 6 meter coverage is a bonus anyway, we can afford to be philosophical and not look a gift horse in the mouth. The writer has personal objections to the RCA phono jack used as the mike connector and it is suspected that many users will change it to a type to fit their microphones.

All in all, the Knight T-60 is a very good buy. For the Novice, it is an ideal first transmitter, and it is very attractive to the more experienced amateur as an emergency or standby unit. The rugged construction and simplicity of the unit make it probable that this little rig will be in service long after more sophisticated equipment is "down for maintenance." RF

Reprinted from the March 1962 issue of 73 Amateur Radio.

Easy Transmitter Protection

Don't cook your TX with a strange impedance.

by Andy Loomis KEØUL

Do you cringe at the thought of transmitting into a completely unknown load? Are you concerned that the automatic high-SWR shutdown circuit in your expensive rig isn't going to work? Would you like to feel at ease if you make a really BIG mistake when adjusting your antenna? This article describes a truly simple method of minimizing the SWR as "seen" by your transmitter, while allowing you to tinker to your heart's content with your antenna system or any other load you wish to play with. No matter what you do, your transmitter will be happy!

Our task is to provide a reasonably constant load to our transmitter, even at the extremes of our folly, which could be the condition of no load at all (an open circuit), or a dead short circuit.

First, we must define what we mean by a "reasonably constant load." Most transmitters are made to drive a 50 ohm load with a maximum 2:1 VSWR. What this means is that the transmitter will do just fine with a load ranging from 25 to 100 ohms. In fact, most transmitters won't suffer any harm if operating into a 3:1 VSWR (17 to 150 ohms). But, for the sake of the more squeamish among us, let's stick to the 2:1 maximum and concoct a device to ensure that our transmitter cannot see, under any circumstances, a higher ratio.

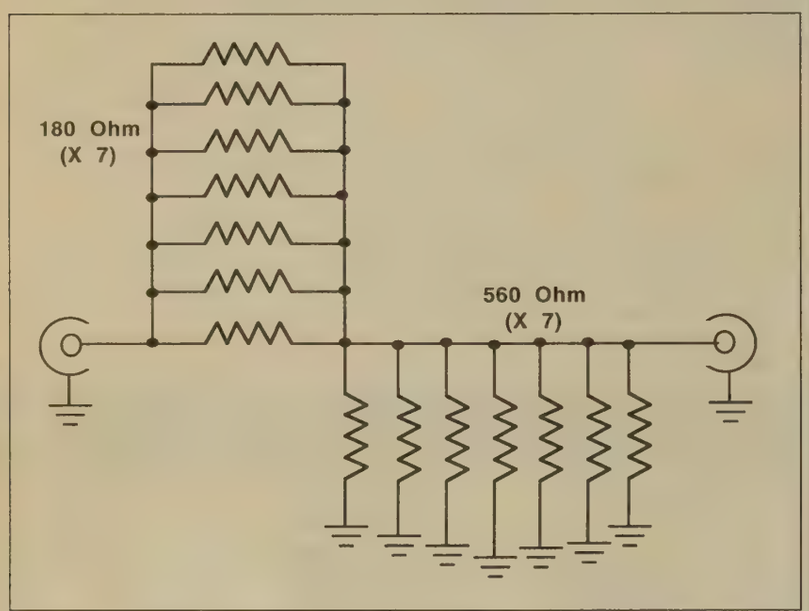


Figure 1. Careful construction of this L-pad attenuator will pay off in performance.

The trick to accomplishing this is to introduce enough attenuation between the transmitter and the load so that the reflected energy is absorbed and dissipated as heat before it can return to the transmitter and upset the impedance matching. Unfortunately, any attenuation we introduce will also have an equal effect on the forward energy, but that is the price we must pay. During antenna adjustments we don't need our full power capacity anyway, so we accept the signal loss in trade for keeping our transmitters happy.

A cable with 5 dB matched loss will show a maximum 2:1 VSWR to an RF source when the far end of the cable is short-circuited. Well, it turns out that 85 feet of RG-58 cable has an attenuation of about 5 dB on the 2 meter band. A 40-foot length of RG-58 gives the same attenuation on the 70cm band. If you connect your transmitter to your antenna using these (or greater) lengths of RG-58 cable, then the SWR at your transmitter cannot exceed 2:1, no matter what!

On the HF bands, however, even RG-58 cable isn't very lossy. It then becomes necessary to construct an attenuator from discrete components. The simplest attenuator is called an "L"-pad. It contains two resistances—a series element and a shunt element. By feeding our transmitter into a series element of 25 ohms, and then shunting the output connection with a 75 ohm resistor, we will satisfy the 5 dB loss requirement and ensure that our transmitter sees a maximum VSWR of 2:1.

The next step is to build the attenuator. Be sure to use only carbon resistors and not wirewound resistors. It is very tempting to use the wirewound variety because they are the ones that come in the higher-power ratings, but don't do it! We must build up our resistors by series or parallel combinations of smaller-wattage resistors.

The series element can be made up of a cluster of seven 180 ohm, 1 watt or 2 watt resistors all wired in parallel in a tight, neat bundle. If you use 1 watt resistors, then the maximum power you can use for testing purposes should be 7 watts. The larger resistors will dissipate 14 watts total. Remember that these are MAXIMUM power levels—resistors are rated for free-air ventilation and by bundling them together we lose a lot of cooling efficiency. On the other hand, we really won't be loading our device with a dead short circuit for very long, either!

The shunt element can be built using a parallel combination of seven 560 ohm, 1/2 watt or 1 watt resistors. The shunt element isn't required to dissipate as much heat as the series element, so use the 1 watt resistors only if you have chosen the 2 watt style for the series element.

Use a small, aluminum box (such as the Radio Shack 270-235) and install your favorite coaxial connector on each end. Take special care to keep the lead lengths of the resistor elements as short as possible, especially at the transmitter input connector. The shorter you can make the leads the better. Sloppy construction will exhibit poor performance on the higher frequency bands.

To use the attenuator when adjusting an antenna, be sure to place your SWR bridge between the attenuator and the antenna. You will want to see the "true" SWR variance as you tune the antenna. For the curious, go ahead and insert the bridge between the transmitter and the attenuator—you will see confirmation of the fact that the SWR at the transmitter cannot exceed 2:1 under any circumstances. RF

FCC Relaxes Restrictions

Continued from page 1

OLD RULE: Except for emergency communications, the ham bands may not be used as an alternative to other authorized radio services.

NEW RULE: Amateur-to-amateur communications which could reasonably be furnished alternatively through other radio services will now be permitted on the ham bands—although not on a regular basis. This will allow amateurs to legally participate with the Weather Service, police and fire departments, parks and forestry service, and many other local, state, and federal agencies. *TNX Westlink Report, No. 654, July 29, 1993* and *W5YI Report, Issue 16, August 15, 1993.*

Clinton is High on Hams in Space

The president of the United States, no less, took time out of his busy schedule recently to extol the virtues of the Shuttle Amateur Radio EXperiment (SAREX) program. While talking to the STS-57 mission astronauts on a special hookup, President Bill Clinton said: "I understand that later in the mission Janice (Voss) and Brian (Duffy N5WQW) are going to be talking with schoolchildren around the world. I just want to tell you how much I appreciate the fact that you're making an international education project out of this mission. That's very important to me."

Astronaut Brian Duffy responded: "Mr. President, we find that using amateur radio is an excellent way of communicating with children all around the world, and we're also able to excite them by using space and science."

President Clinton concluded: "You may be on this mission, creating thousands of scientists for the future just by the power of your example and by this direct communication. I think sometimes we underestimate the impact that human contact in an enormously impressive setting like this can have on children across the world—not only those with whom you talk, but millions of others who will just see it and know that it happened." *TNX Westlink Report No. 653, July 15, 1993* and *W5YI Report, Issue 13, July 1, 1993.*

Vanity Callsigns Authorized

Both the House and Senate have approved legislation authorizing the FCC to issue unique amateur radio callsigns, at a cost of $7 per year, to the ham community. The surprise measure was inserted into the recently signed deficit reduction bill of President Clinton.

According to a congressional aid close to the plan, "We envision that the legislation will probably be implemented so that an amateur pays $35 every five years, although there is no language in the bill that says they have to do it that way. It only says they have the authority because they do not have this authority right now. . . . As I understand it, the proceeds will go to the FCC to augment their budget, . . . pay for equipment, staff, and stuff." The only amateurs who would be subject to the new fees are those requesting special, distinctive callsigns.

Another little-known tack-on to the deficit plan provides for spectrum auctions. The government is set to receive more than $10 billion over the next five years when it sells radio spectrum to the highest bidder for new communications services. *TNX W5YI Report, Issue 16, August 15, 1993.*

Technician is Hot Ticket

The Technician Class amateur radio license is maintaining its accelerated growth rate of 20%—by far the fastest growing ham class. Before 1991, amateur radio overall grew at only a sluggish 3% rate. Today, that figure is a healthy 10%. If the rate of growth of amateur radio continues on the track it's on now, we will surpass one million licensed ham operators by 1998.

In 1985, only one amateur in five was a Technician. But since the arrival of the Codeless Technician Class in 1991, the demographics have shifted significantly. Today, one third of all hams are Techs. *TNX W5YI Report, Issue 13, July 1, 1993.*

Codeless Coast Guard

For the first time since 1924, the United States Coast Guard has closed down its Morse code operations on 500 kHz. The final CW transmission ended an era at 000Z, July 31, 1993. Coast Guard radio operators first began listening for distress signals on 500 kHz at the turn of the century, and set up its permanent station nearly 70 years ago to monitor the frequency continuously.

Officials say the advent of satellite and digital technology has made Morse code obsolete on the high seas. A misty-eyed Coast Guard radioman tapped out the final 73, saying "We now look forward to serving you on the next generation of communications equipment and systems via the Global Marine Distress and Safety System (GMDSS)." *TNX W5YI Report, Issue 16, August 15, 1993.*

Lunar Repeater

Northern California's Project OSCAR group has proposed installing the first repeater on the moon. Project OSCAR is the group that built and orbited the world's first amateur radio satellite. During recent meetings, the organization has decided to revive "Project Moonray" to take amateur radio into the 21st century.

Moonray is short for Moon Relay, a concept first proposed by W6OLO back in 1965. The idea was to build a repeater that would fit under the seat of the Lunar Rover. But, the project was shelved after Congress cut funding for manned moon missions beyond Apollo 17.

No specific timetable has been offered, although organizers hope to get the project off the ground by the turn of the century—which is only six years and a few months away. *TNX Westlink Report No. 655, August 13, 1993.*

Easy Transmitter Protection

Don't cook your TX with a strange impedance.

by Andy Loomis KEØUL

Do you cringe at the thought of transmitting into a completely unknown load? Are you concerned that the automatic high-SWR shutdown circuit in your expensive rig isn't going to work? Would you like to feel at ease if you make a really BIG mistake when adjusting your antenna? This article describes a truly simple method of minimizing the SWR as "seen" by your transmitter, while allowing you to tinker to your heart's content with your antenna system or any other load you wish to play with. No matter what you do, your transmitter will be happy!

Our task is to provide a reasonably constant load to our transmitter, even at the extremes of our folly, which could be the condition of no load at all (an open circuit), or a dead short circuit.

First, we must define what we mean by a "reasonably constant load." Most transmitters are made to drive a 50 ohm load with a maximum 2:1 VSWR. What this means is that the transmitter will do just fine with a load ranging from 25 to 100 ohms. In fact, most transmitters won't suffer any harm if operating into a 3:1 VSWR (17 to 150 ohms). But, for the sake of the more squeamish among us, let's stick to the 2:1 maximum and concoct a device to ensure that our transmitter cannot see, under any circumstances, a higher ratio.

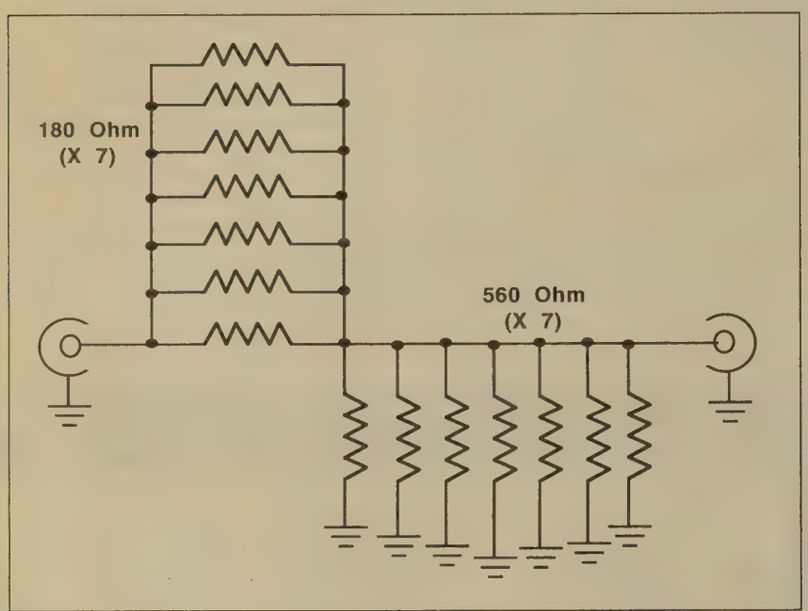


Figure 1. Careful construction of this L-pad attenuator will pay off in performance.

The trick to accomplishing this is to introduce enough attenuation between the transmitter and the load so that the reflected energy is absorbed and dissipated as heat before it can return to the transmitter and upset the impedance matching. Unfortunately, any attenuation we introduce will also have an equal effect on the forward energy, but that is the price we must pay. During antenna adjustments we don't need our full power capacity anyway, so we accept the signal loss in trade for keeping our transmitters happy.

A cable with 5 dB matched loss will show a maximum 2:1 VSWR to an RF source when the far end of the cable is short-circuited. Well, it turns out that 85 feet of RG-58 cable has an attenuation of about 5 dB on the 2 meter band. A 40-foot length of RG-58 gives the same attenuation on the 70cm band. If you connect your transmitter to your antenna using these (or greater) lengths of RG-58 cable, then the SWR at your transmitter cannot exceed 2:1, no matter what!

On the HF bands, however, even RG-58 cable isn't very lossy. It then becomes necessary to construct an attenuator from discrete components. The simplest attenuator is called an "L"-pad. It contains two resistances—a series element and a shunt element. By feeding our transmitter into a series element of 25 ohms, and then shunting the output connection with a 75 ohm resistor, we will satisfy the 5 dB loss requirement and ensure that our transmitter sees a maximum VSWR of 2:1.

The next step is to build the attenuator. Be sure to use only carbon resistors and not wirewound resistors. It is very tempting to use the wirewound variety because they are the ones that come in the higher-power ratings, but don't do it! We must build up our resistors by series or parallel combinations of smaller-wattage resistors.

The series element can be made up of a cluster of seven 180 ohm, 1 watt or 2 watt resistors all wired in parallel in a tight, neat bundle. If you use 1 watt resistors, then the maximum power you can use for testing purposes should be 7 watts. The larger resistors will dissipate 14 watts total. Remember that these are MAXIMUM power levels—resistors are rated for free-air ventilation and by bundling them together we lose a lot of cooling efficiency. On the other hand, we really won't be loading our device with a dead short circuit for very long, either!

The shunt element can be built using a parallel combination of seven 560 ohm, 1/2 watt or 1 watt resistors. The shunt element isn't required to dissipate as much heat as the series element, so use the 1 watt resistors only if you have chosen the 2 watt style for the series element.

Use a small, aluminum box (such as the Radio Shack 270-235) and install your favorite coaxial connector on each end. Take special care to keep the lead lengths of the resistor elements as short as possible, especially at the transmitter input connector. The shorter you can make the leads the better. Sloppy construction will exhibit poor performance on the higher frequency bands.

To use the attenuator when adjusting an antenna, be sure to place your SWR bridge between the attenuator and the antenna. You will want to see the "true" SWR variance as you tune the antenna. For the curious, go ahead and insert the bridge between the transmitter and the attenuator—you will see confirmation of the fact that the SWR at the transmitter cannot exceed 2:1 under any circumstances. RF

FCC Relaxes Restrictions

Continued from page 1

OLD RULE: Except for emergency communications, the ham bands may not be used as an alternative to other authorized radio services.

NEW RULE: Amateur-to-amateur communications which could reasonably be furnished alternatively through other radio services will now be permitted on the ham bands—although not on a regular basis. This will allow amateurs to legally participate with the Weather Service, police and fire departments, parks and forestry service, and many other local, state, and federal agencies. *TNX Westlink Report, No. 654, July 29, 1993* and *W5YI Report, Issue 16, August 15, 1993.*

Clinton is High on Hams in Space

The president of the United States, no less, took time out of his busy schedule recently to extol the virtues of the Shuttle Amateur Radio EXperiment (SAREX) program. While talking to the STS-57 mission astronauts on a special hookup, President Bill Clinton said: "I understand that later in the mission Janice (Voss) and Brian (Duffy N5WQW) are going to be talking with schoolchildren around the world. I just want to tell you how much I appreciate the fact that you're making an international education project out of this mission. That's very important to me."

Astronaut Brian Duffy responded: "Mr. President, we find that using amateur radio is an excellent way of communicating with children all around the world, and we're also able to excite them by using space and science."

President Clinton concluded: "You may be on this mission, creating thousands of scientists for the future just by the power of your example and by this direct communication. I think sometimes we underestimate the impact that human contact in an enormously impressive setting like this can have on children across the world—not only those with whom you talk, but millions of others who will just see it and know that it happened." *TNX Westlink Report No. 653, July 15, 1993* and *W5YI Report, Issue 13, July 1, 1993.*

Vanity Callsigns Authorized

Both the House and Senate have approved legislation authorizing the FCC to issue unique amateur radio callsigns, at a cost of $7 per year, to the ham community. The surprise measure was inserted into the recently signed deficit reduction bill of President Clinton.

According to a congressional aid close to the plan, "We envision that the legislation will probably be implemented so that an amateur pays $35 every five years, although there is no language in the bill that says they have to do it that way. It only says they have the authority because they do not have this authority right now. . . . As I understand it, the proceeds will go to the FCC to augment their budget, . . . pay for equipment, staff, and stuff." The only amateurs who would be subject to the new fees are those requesting special, distinctive callsigns.

Another little-known tack-on to the deficit plan provides for spectrum auctions. The government is set to receive more than $10 billion over the next five years when it sells radio spectrum to the highest bidder for new communications services. *TNX W5YI Report, Issue 16, August 15, 1993.*

Technician is Hot Ticket

The Technician Class amateur radio license is maintaining its accelerated growth rate of 20%—by far the fastest growing ham class. Before 1991, amateur radio overall grew at only a sluggish 3% rate. Today, that figure is a healthy 10%. If the rate of growth of amateur radio continues on the track it's on now, we will surpass one million licensed ham operators by 1998.

In 1985, only one amateur in five was a Technician. But since the arrival of the Codeless Technician Class in 1991, the demographics have shifted significantly. Today, one third of all hams are Techs. *TNX W5YI Report, Issue 13, July 1, 1993.*

Codeless Coast Guard

For the first time since 1924, the United States Coast Guard has closed down its Morse code operations on 500 kHz. The final CW transmission ended an era at 000Z, July 31, 1993. Coast Guard radio operators first began listening for distress signals on 500 kHz at the turn of the century, and set up its permanent station nearly 70 years ago to monitor the frequency continuously.

Officials say the advent of satellite and digital technology has made Morse code obsolete on the high seas. A misty-eyed Coast Guard radioman tapped out the final 73, saying "We now look forward to serving you on the next generation of communications equipment and systems via the Global Marine Distress and Safety System (GMDSS)." *TNX W5YI Report, Issue 16, August 15, 1993.*

Lunar Repeater

Northern California's Project OSCAR group has proposed installing the first repeater on the moon. Project OSCAR is the group that built and orbited the world's first amateur radio satellite. During recent meetings, the organization has decided to revive "Project Moonray" to take amateur radio into the 21st century.

Moonray is short for Moon Relay, a concept first proposed by W6OLO back in 1965. The idea was to build a repeater that would fit under the seat of the Lunar Rover. But, the project was shelved after Congress cut funding for manned moon missions beyond Apollo 17.

No specific timetable has been offered, although organizers hope to get the project off the ground by the turn of the century—which is only six years and a few months away. *TNX Westlink Report No. 655, August 13, 1993.*

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO 211 MANCHESTER NH

POSTAGE WILL BE PAID BY ADDRESSEE

Radio Fun

PO Box 4926
Manchester NH 03108-9839

Place
Stamp
Here

Radio Fun

READER SERVICE MANAGEMENT DEPARTMENT
PO BOX 8708
BOULDER CO 80329-8708

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST-CLASS MAIL PERMIT # 707 RIVERTON NJ

POSTAGE WILL BE PAID BY ADDRESSEE

73 Amateur Radio Today
PO BOX 7693
RIVERTON NJ 08077-8793

advertiser index

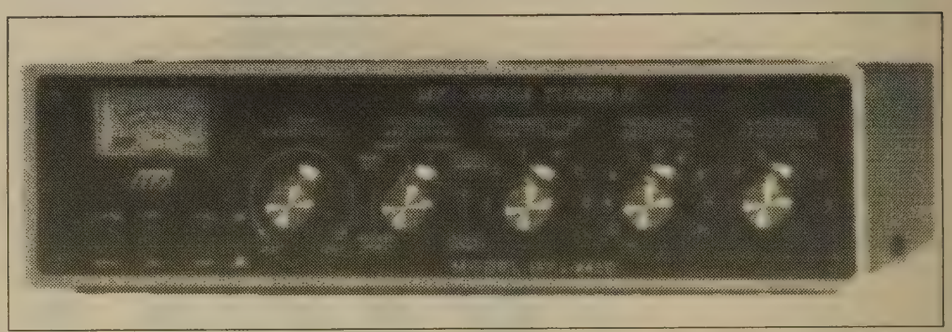
RF review

MFJ Enterprises, Inc.
PO Box 494
Mississippi State MS 39762
Tel. (601) 323-5869;
FAX: (601) 323-6551;
Orders: (800) 647-1800
Price Class: $101.95

MFJ's 941D Versa Tuner II

Antenna tuner/SWR bridge in one versatile unit.

by Pete Putman KT2B



We amateur radio operators are fairly smart fellows, aren't we? After all, we have to master Morse code and comprehend a wide variety of technical topics ranging from baud rates to beamwidth. We understand feedpoint impedance, reactance, resonance, angles of radiation, and the care, feeding and use of baluns, right?

So how do we account for all these guys who load up gutters as antennas, operate 160 meters using 15 feet of longwire in the attic, and insist on using a tribander to call CQ on 75 phone? Hmmmm?

The truth is that our world is full of compromise. Sure, we know darn well that a half-wave dipole for 160m takes up 240 feet, and it should be at least 60 feet above the ground to do any good, and we must use a balun at the feed point. Then we go outside, toss 30 feet of wire across some tree branches, just out of reach, and try to work 4X4s with it. (Sigh . . .)

If necessity is the mother of invention, then compromise is the mother of the antenna tuner. There are probably more variations of this device on the market today than there are handie-talkies—a staggering thought! And yet without them, many amateurs would not have worked those 4X4s on 160, 80 or even 40 meters. The antenna tuner is indeed a key part of an amateur's station. And so it is for me with the MFJ 941D Versa Tuner II, a 300W PEP tuner incorporating an SWR bridge, power meter and 4:1 balun all in a tidy box.

Lured by Sunspots

After spending the better part of the last six years on VHF and UHF, I've grown accustomed to broad-banded 50 ohm antenna feeds. But the siren song of sunspots has lured me back to HF and the attendant problems with antennas. I recently erected a Cushcraft A3 tribander with a 40 meter add-on kit, and while it works quite well, my Kenwood TS-430S doesn't like to load into it at several points in the 40 and 15 meter bands.

As a compromise, I set the elements on the A3 for coverage of the middle portion of 40 meters, resulting in VSWR readings of over 2:1 below 7.090 and above 7.220 MHz. I also obtained 2:1 readings below 21.375 MHz (10 meters and 20 meters are under 2:1 across each band). Time to pick up an antenna tuner!

Why Use a Tuner?

Modern solid-state transceivers want to see a range of 50 to 75 ohms in everyday operation. Internal ALC circuits measure increased collector current as a function of VSWR mismatches and "throttle back" the drive to keep maximum current below a specified value, thus insuring long life for your final transistors. Most transceivers have their ALC circuits set to "kick in" at about a 1.5:1 VSWR (75 ohms), but the truth is that with ballasted emitter devices in the finals, 2:1 mismatches don't present much of a problem.

I've reset the ALC circuit in my HG radios to allow as much as a 2:1 mismatch, thereby allowing greater frequency excursions for a given antenna. It's only when impedances reach above 2:1 that things get tricky, and here's where an antenna tuner really helps out. But the important point to remember is to optimize your antenna for the chosen band. Get it as high as possible, strive for the longest possible physical length with respect to optimum, and use a good ground. If your tuner is looking at realistic impedances, it can be a potent tool.

MFJ Tuners, and the 941D in Particular

MFJ manufactures a bewildering array of tuners, starting with the 16010 Random Wire model and stretching all the way up to the MFJ 989C 3 kW version. I considered using the scientific method of closing my eyes and throwing a dart at the page to make a choice, but after careful study decided on the 941D for several reasons: (1) I only run 100 watts on HF; (2) it has a built-in SWR bridge/power meter; and (3) it will handle two coaxial lines, one balanced and one unbalanced.

The 941D Versa Tuner packs quite a bit in a small package. It checks in at 3" H x 10" W x 7" D, and weighs just a couple of pounds. The chassis is finished in black, fitting right in with most of today's transceivers. Front panel controls from left to right are: SWR SENSITIVITY, ANTENNA SELECTOR, TRANSMITTER MATCHING, INDUCTOR SELECTOR, and ANTENNA MATCHING. In addition, push-buttons select FWD/REV, 300/30W range, or POWER/SWR functions on the front panel meter.

Rear panel connections are for BYPAS COAX, COAX 1, COAX 2, and a combination of binding posts that allow connection of an unbalanced wire, balanced feedline and ground. The 941D has a built-in 4:1 balun for a 200 or 300 ohm ladder or ribbon line, with a maximum rating of 300 watts PEP. Theoretically, you could have two coax lines and one longwire connected at the same time to the 941D. (Note that the BYPASS COAX does just that and is routed around the tuner.)

Electrically, the tuning circuit is a "T-match" system, using two variable capacitors in series with a tapped inductor shunted to ground. One would expect this circuit to exhibit a moderately high Q, similar to a "T section" filter. And it does, as the optimum settings for a given match are quite narrow—that is, one setting of the inductor is usually best. Where the mismatch is more severe, the settings on the 941D become critical. Conversely, when presented with impedances in the 75 to 100 ohm range, the tuning is quite broad.

So far, I've been able to match up random 500-600 ohm longwire antennas, using a good ground connection as a counterpoise. The settings are very sharp, but stable and repeatable . . . very important when contesting and jumping around between bands. And there's been no evidence of the balun core saturating at this power level. The 941D's power and SWR meter agree quite closely with a Bird 43 Thruline on all bands from 160 through 10 meters. A toroidal coupler is used, as the sensitivty of wattmeters is usually quite low in the HF range. SWR is calculated by setting the front panel control for a full meter deflection, then switching to REF.

Using the 941D, I'm able to set up the A3 on 40 meters to operate under 2:1 from 7.200 to 7.300, or from the low end of the band up through 7.125, just by changing the inductor setting. Fifteen meters is similarly covered with one setting, resulting in under 2:1 performance across most of the band. In either case, you can get the A3's original settings by switching either coax line to DIRECT on the front panel, so rapid QSYing is a breeze.

For 160 and 80 meter operation, I'll use an end-fed 250' longwire, connecting a balun at the feed point to eliminate RF burns in the shack. By attaching the counterpoise outside and transforming down to open wire line, the internal 4:1 balun will be matching 150-200 ohms to 50 ohms unbalanced, and it should tune fairly smoothly. Pretty versatile! RF

Reprinted from the February, 1990 issue of 73 Amateur Radio.

the tech side

by Michael Jay Geier KB1UM

Getting Heard

Last month, we were discussing RF power and how to use it to your best advantage. Let's continue:

Efficiency

Obviously, you want to get as much of your RF power to the listener's receiver as you can. Between your transmitter and the other ham's receiver are five things: two antennas, two feedlines and space itself. But how much of the power you are generating is even making it out into space?

You have control over only two of those elements, so it pays to do the best you can with them. First, how much power are you losing in your feedline? If you're losing, say, 3 dB, half your power is getting wasted warming up your coax! On the HF bands, cable loss usually is very low, but on VHF and UHF it can be quite significant. Second, there's the matter of SWR (standing wave ratio). SWR refers to the ratio of how much power is being accepted by the antenna and radiated into space to how much is being rejected and sent back down the feedline. It is one of the most controversial subjects in all of ham radio. Essentially, your SWR is a function of how well-tuned your antenna is to your operating frequency. Antennas resonate electrically in the same sense that violin strings resonate mechanically; both resonances occur because it takes a certain amount of time for the energy to get from one end of the antenna or string to the other. If you try to excite a string with a pitch different from the one to which it is tuned, it won't vibrate along with it. Likewise, a mistuned antenna will not accept much of the RF energy applied to it.

So where does that energy go? Like I said, it goes back down the feedline to your transmitter! Now, here's where the controversy comes in. Some people say that, as long as you have a way of protecting the transmitter from being damaged by all that returning energy (an antenna tuner is the usual solution), SWR really doesn't matter because the energy will just bounce back and forth on the feedline until it gets accepted, little by little, by the antenna and sent into space. Other people say that even a moderate SWR is like the bubonic plague: to be avoided at all costs. Who's right?

The truth seems to be somewhere in between. A moderate SWR, perhaps 1.4 to 1, doesn't seem to make much, if any, difference in how your signal appears at the receiving end. On the other hand, a 5 to 1 SWR will make for poor performance no matter what kind of tuner you use. If the energy really does bounce back and forth on the feedline until it gets radiated, why does that high SWR cause so much reduction in radiated signal?

I'm Getting Weaker . . .

We're back to cable losses again. As the signal bounces back and forth, it gets weaker and weaker because of the resistance and other losses in the feedline, with the result that only *some* of it finally gets radiated; the rest just warms the coax. If that weren't true, you could inject some RF at one end of a cable, short the other end, walk away and still find it zinging back and forth days later! Obviously, that won't happen. By the same token, two mirrors facing each other won't keep reflecting a single pulse of light for any observable period of time. (Admit it, you tried this as a kid, didn't you? I did.)

The Skyhook

Antennas are a complex, fascinating subject about which many hams know more than I do. Lots of hams love them. They love designing and building them, talking about them and even fighting about them. I do not; I'm a circuit guy and find antennas a nuisance. So, I won't attempt to go into any great detail about them; I'll just bring up a few basic points. If you like antennas, there are plenty of books and articles on the subject to get you started.

First, some kinds of antennas concentrate your RF power in a particular direction. These directional antennas are generally called beams. If you aim most of your energy at the receiver, it works the same as if you had lots more power into an omnidirectional antenna. Beam antennas are used by virtually all the "serious" HF operators. I mean the ones who spend thousands for their stations and operate in contests and such. Plenty of VHF and UHF operators use them, too. Beams have the added benefits of limiting interference from stations in other directions (because the beam effect is there in receive, too) and reducing interference to other stations not in the beam's path.

Second, the vertical angle at which an HF antenna sends a signal determines, to some degree, the distance at which it will be refracted back to earth. The lower the angle of radiation, the farther the skip distance. Since you can't get anywhere pointing into the earth, the best you can do is point at the horizon and make that horizon as far away as possible by putting the antenna up as high as you can.

The Signal Itself

I mentioned that, on SSB, the "loudness" of your signal does depend, at least to a degree, on the signal strength. The reason I qualify that statement is because how loud you sound depends more on certain characteristics of your modulated signal than on your absolute signal strength.

Just an Average Signal

If you've ever talked into a microphone and watched your voice waveform on an oscilloscope, you know that the human voice makes a remarkably complex series of sounds. One of the peculiar facets of the voice waveform is that it has occasional strong peaks, with most of the sounds being significantly softer. In fact, there's quite a dynamic range (the difference between the softest and loudest sounds) between some phonemes (the 64 sounds comprising human speech) and others. A big dynamic range may sound awesome on a classical music CD, but it's the last thing we want on ham radio!

How come? The HF radio bands are filled with noise and static, not to mention interference from other stations. It's a real zoo out there! If your signal has a big dynamic range, the softer sounds simply will get lost under all the noise. Unfortunately, your receiver's automatic gain control (AGC) will make sure of it. Here's why:

Clamping Down

SSB, being a special form of AM, sends your voice by modulating (changing) the strength of the RF power coming from your transmitter, in step with your voice waveform. Because your signal may go halfway around the world, though, the absolute strength of it can vary quite a bit from moment to moment. If we make our receiver respond only to the signal's strength, the resulting volume changes resulting from fading, interference, etc., will drive us out of our minds. One moment the signal may be barely audible and the next moment it may blast us out of our chairs. We certainly can make receivers that way, and many were like that in the early days. But there's a way out, and virtually all modern radios employ it.

It's called AGC. Luckily for us, the fading in and out of radio signals occurs much slower than the frequencies present in voice signals. The lower end of the vocal spectrum is about 200 to 300 Hz, while fading occurs in the 0.25-to-2-second range, which corresponds to between about 4 to 0.5 Hz. So, it's easy to make a circuit which ignores the fast changes of voice modulation but can follow the slow fades.

And that's just what AGC does. As the signal fades up and down, the circuit controls the radio's overall gain inversely. In other words, when the signal gets weak, the gain goes up, and when the signal booms in, the gain goes down. The result is that the signal appears to stay at a fairly constant level, and thus a fairly constant volume. Ahhh, much more comfortable.

I know I've taken the long way around here, but the point I'm trying to make is that your apparent loudness depends on the range between your softest and loudest sounds, not on your signal strength (unless, of course, it's very, very weak). The bigger the vocal dynamic range, the softer you sound, because your average voice level is so much lower than the peak level.

Sometimes Faster Isn't Better

So, why not simply speed up the response of the AGC circuit and let it reduce the dynamic range of your voice signal so that you can hear the softer sounds? Well, you can do that, but, of course, it also brings up all that noise and static, too! If you have a radio with a FAST/SLOW AGC control, try putting it on FAST and you'll see what I mean. It does indeed make the voice signal sound compressed, but all that extra noise pumping up and down more than offsets any benefit.

At the Source

But why not compress the dynamic range at the transmitter, causing the various vocal sounds to be nearly at the same level before you even send them into the ether? That way, the receiver will hear them all and the background noise will not be increased. That's exactly what a speech processor does. All but the lowest-cost HF rigs made today have some form of a speech processor. Using one makes your signal sound a *lot* louder, without actually increasing the maximum power output of your rig. Of course, what you're doing is increasing the *average* power, which was fairly low before you turned the processor on.

Abuse

Speech processors are great, but they are easily abused. If you turn one up too high, it really distorts your voice and can even cause "splatter" by increasing your transmit bandwidth. That's not only annoying, it's illegal!

Voice Tailoring

Another way to increase your apparent signal strength is to adjust the frequency response of your microphone. We get most of our intelligibility from the higher sounds in our speech. I don't mean the hi-fi range out at 20 kHz, I mean the range from maybe 1 to 3 kHz. A microphone or equalizer that is made to weaken the lower sounds, thereby comparatively increasing the higher ones, gives you "punch" and makes you very intelligible, even with a weak signal. Be careful, though. Just as with speech processing, you can carry this too far and ruin your signal.

Well, I think we've covered most of the essentials of getting yourself heard. Happy transmitting and see you all next time. 73 from KB1UM. RF

radio magic

by Michael Bryce WB8VGE

Here's another antenna project for you to enjoy before autumn's gentle days drift into winter's frozen night. This time it's an antenna called the "center feed zepp," and it is really easy to build. It is so easy, in fact, that you can get ALL the parts at your local Radio Shack and there is *nothing* to cut or measure.

You will need a heavy-duty soldering iron or a small propane torch for soldering the connections together. But the soldering isn't complicated—you won't even have to solder a PL239 connector. But you will have to use an antenna tuner and the tuner will need a 4:1 balun or, as it is sometimes called, the "open wire" feed option. An external SWR meter might also come in handy (Figure 1), although some newer rigs have these built-in.

This antenna design will cover all the main ham bands except for 160 meters (1.8 MHz). You can even add 160 meters if you want to by increasing the length of the antenna. As it is now, you get coverage from 80 to 10 meters (3.5 MHz to 28 MHz), including the WARC bands.

You can install this antenna either as a horizontal dipole or as an inverted Vee. It depends on your lot size and preferences. You can also shorten the elements, but you'll lose some band coverage, especially on the lower frequencies such as 80 and 75 meters.

Construction is Simple

The only part for this antenna you'll have to cook up yourself is the center block. (See Figure 2.) I made mine out of a small hunk of plastic. A piece of sealed wood would work just as well. So would just about any other type of non-conductor. Whatever you choose, make it something easy to work with that will stand up to the weather and the UV light from Mr. Sun. You would be surprised at the amount of damage just one year's exposure to the elements can do to an antenna!

On your shopping trip, pick up two packages of antenna wire, each 70 feet long. (So, from end to end, the antenna will be 140 feet long, not including the support lines.) Get one package of 300 ohm TV twin lead. A roll or two of support line will be required also. I use nylon cord for this as it is both lightweight and survives exposure to the sun. Only you will know how much line to get. One package of antenna end insulators, a roll of electrical tape, and a tube of RTV sealer will complete your shopping trip.

The Center Insulator

In Figure 2, you will see the dimensions of the plastic block I used to make my version of this antenna. You don't have to duplicate these exact dimensions—we're not launching missiles here.

Start by drilling out the center insulator. I used a drill press and some hand files to get the job done. The idea is to provide two slots in the material so we can wrap the twin lead through and back again on itself. This will help keep the strain off of the feedline. Two holes in the ends allow us to tie off the ends of the antenna wire while providing a strain-free place to solder our twin lead to. A hole may be drilled in the center to support the antenna as an inverted Vee.

After you have drilled the center insulator, attach one end of each coil of antenna wire to the center insulator. Do not uncoil the wires yet! If you do, you'll end up with a giant mess on your hands. Attach the twin lead, one wire to each side of the insulator, and solder the connections. Be sure you have a good connection on both sides; this is not the place to have a cold solder joint, especially when it's hanging 40 feet in the air. Now, apply a large glob of RTV sealer to the entire insulator, especially on the soldered connections we just made. After you have allowed the RTV to set for about 24 hours, tape up the entire mess with your roll of electrical tape. The tape will protect the ends of the twin lead and will prevent damage by the sun to the insulator block.

Finish construction by adding the end insulators to the wires. Don't uncoil the wires just yet. Solder these to keep them from pulling apart. Add your support lines to the ends of each insulator. Now comes the fun part—getting the thing in the air

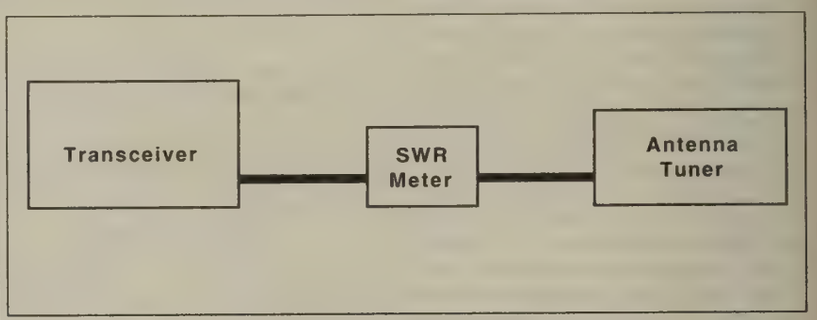


Figure 1. Adjusting the antenna tuner for lowest SWR.

without getting all tangled up in one huge knot.

Safety First!

Before you install any antenna, check your location for overhead wires. *If your antenna falls across a power line, you are in danger of being killed.* If you do drop your antenna across any power lines, don't touch it, let it fall—don't try to remove it. Call your local power company.

If you're lucky enough to install the antenna as a horizontal dipole, then fasten one end of one 70-foot wire to your support using the support line. Unwind the coil carefully as you walk it out. This copperweld wire tangles very easily. Now, do the same for the other side as you pull the antenna up into the air.

Inverted Vee style installation requires a bit more skill and perhaps a helper, too. Hoist the center insulator up about 12 feet or so as you play out the ends of the coils. Try (and it's much easier said than done) not to get the wires tangled together or with the feedline. Again, watch out for those power lines!

Tune Up

Connect the open line feed to your antenna tuner at the proper location. Most antenna tuners have the location marked very clearly for open line feeders. Start with the controls in the middle positions and, while you're listening to the rig, tune for maximum sound from the receiver. This will put you real close to the resonant point of the tuner. Apply a small amount of RF (after listening to be sure the frequency is clear) and adjust the antenna tuner for the lowest SWR as shown on a wattmeter or SWR bridge. Some of the newer transceivers have an SWR bridge built in. Figure 1 shows a complete setup of rig, SWR meter and antenna tuner.

Why It Works

The key to this antenna is the feedline. The open line feed has very low loss characteristics. It's much better than coax and much cheaper too. When coupled to a tuner, you match the antenna's impedance to the rig's 50 out output. All the RF then gets radiated into the air with very little being lost. Of course, there is always some loss when using an antenna tuner, but it's a small trade-off for this kind of performance.

Well then, if open line feed is so great, why don't we see it more often? That's a good question—and the answer is quite simple. Open line feed is harder to handle than coax. If it gets wet, it won't work as well as when it's dry. The wind blowing the feedline around will change its operating characteristics. You can see the results as you watch the SWR change while the wind is blowing.

You must keep open wire feedline away from metal objects. This includes mast pipes, spouting, aluminum siding, and so on. Remember the old standoffs you used to use for TV twin lead on your outside TV antenna? Coax is much easier to work with. You can tape the stuff to the mast pipe and practically tie it in knots, it won't affect the output of your gear.

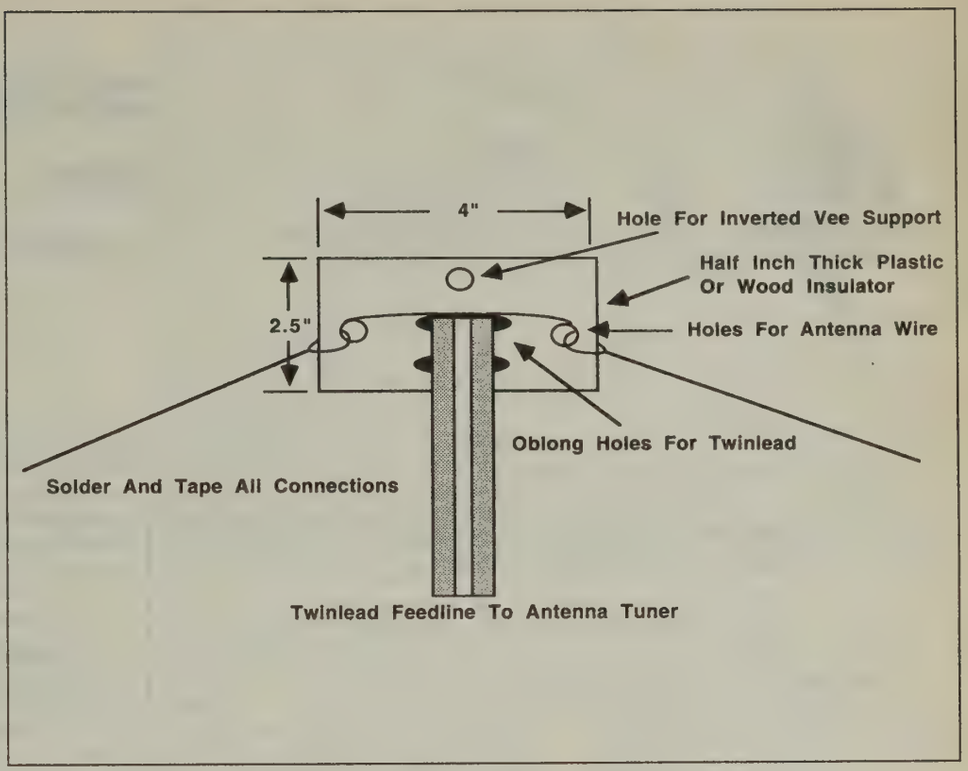


Figure 2. Antenna insulator block construction detail.

Does It Work?

The center feed zepp works great across all bands. During this year's Field Day operation, I used this antenna strung up between two trees. Running my usual QRP power of 2.5 watts, I could answer just about everything I could hear. I was especially pleased by our success on 80 meter CW. I even managed to work quite a few SSB stations running my QRP power. Operating SSB while running QRP is not an easy task, especially during Field Day.

Have fun building this antenna project. Most hams find building antennas a great part of the hobby. Antennas like this are fun, simple and cost effective.

Next month we'll check out what to do when the bands are just plain dead. Stay tuned for more "Radio Magic." RF

antennas, etc.

by Joseph J. Carr K4IPV

Antenna Angle of Radiation

Long-distance radio propagation occurs in the high frequency (HF) shortwave bands (and lower VHF bands) because of ionospheric "skip." Radio signals from the surface are refracted in the ionosphere, and some of them refract enough to undergo total internal reflection, i.e. they head back towards the surface. The skip distance (Figure 1) determines how far one can work other stations. The radio wave is transmitted at the angle of radiation into the ionosphere, where it is refracted enough to bend back to earth, where it can be received. In the distance between where the local ground wave dies out and where the sky wave is received is a dead zone of no reception. At higher frequencies (e.g. 10-20 meters), the ground wave may die out quite rapidly (only a few miles), and the skip distance is very long. As a result, it is not uncommon to find two stations 40 miles apart unable to hear each other, and therefore have their QSO relayed by a DX station. I've had many a QSO where stations in Baltimore, Maryland, only 35 miles from my QTH, had to have a South American station relay messages to me! Very long distance communications occur when multihop skip occurs. An Australian radio scientist, who I met at an engineering conference, recently told me of observing seven and nine hop propagation between Australia (VK) and England (G) using professional ionospheric sounding methods.

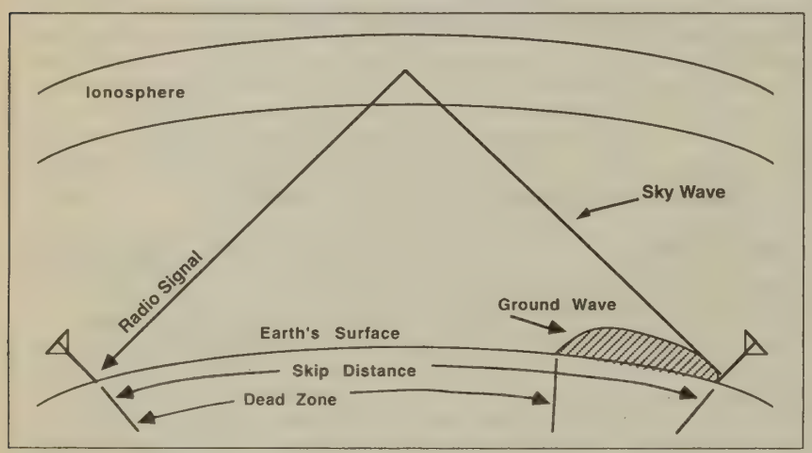


Figure 1. The skip distance is a function of the angle of radiation.

One of the factors that affects the length of the skip distance is the angle of radiation of the radio wave. This angle is partially a function of the operating frequency, and partially a function of the natural radiation angle of the antenna. The frequency effects are seen as a function of the iononization level, and how much a given frequency is refracted. Thus, skip distance can be determined by frequency selection.

The antenna radiation angle is the angle of the vertical lobe with respect to the earth's surface (Figure 2), and is partially a function of its design and partially of its installation configuration. For example, a 5/8-wavelength vertical antenna tends to have a lower angle of radiation than a 1/4-wave vertical antenna. Similarly, the dipole's angle of radiation is a function of its height above ground. By selecting the type of antenna, and its mounting height, you can regulate whether you are going to see longer or shorter distances on each "hop" of your signal. In general, lower angles of radiation provide longer DX contacts.

"An annular eclipse differs from a total eclipse because the perceived diameter of the moon as it blocks the sun's light is smaller than the solar disk, so the result is a 'ring of fire' in the sky."

Figure 3 shows how angle of radiation affects skip distance. Low angle of radiation signals tend to travel farther with respect to the earth's surface before refracting, so they produce the longest skip distances. Higher angles of radiation (1) have shorter skip distances (A-B) because they tend to return to earth rapidly. In summertime, some high frequency bands

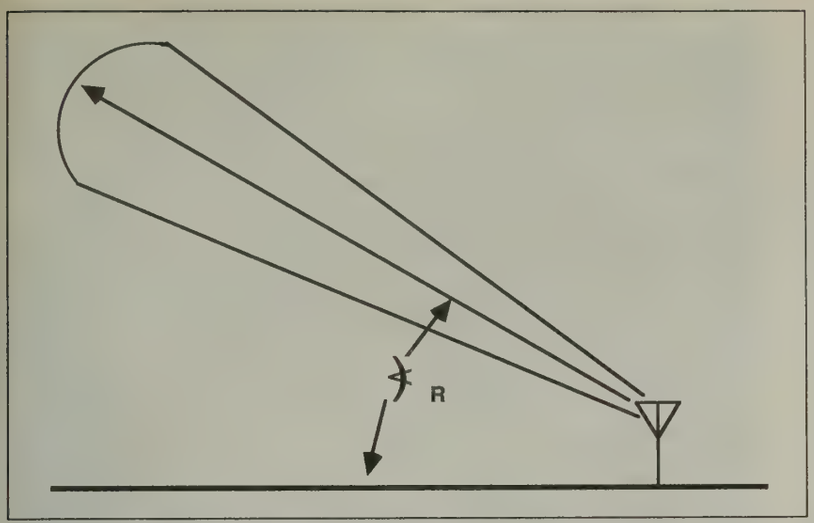


Figure 2. The angle of radiation is the angle between the maximum signal line of the elevation lobe and the earth's surface.

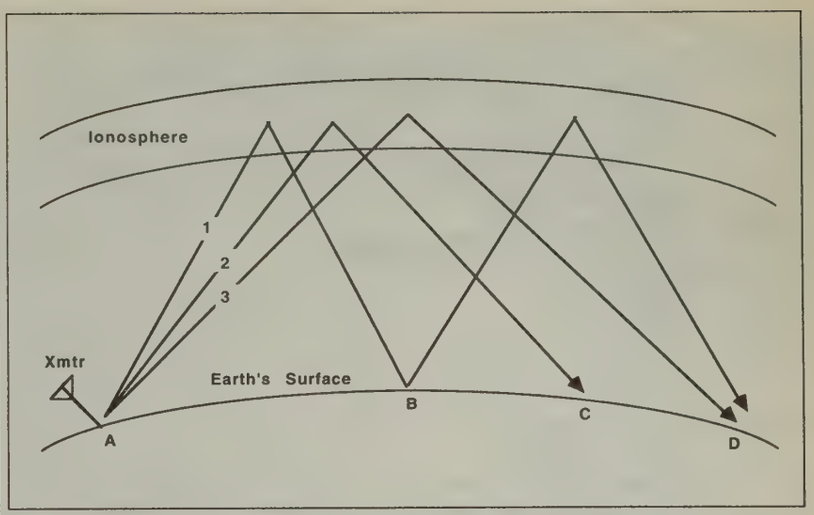


Figure 3. Skip distance is a function of the angle of radiation and the number of hops the signal makes.

(e.g. 10 meters) offer high-angle "short skip," and longer skip during the other months. The difference is the level of ionization of the ionosphere. At higher angles of radiation, there will be a critical angle wave and escape angle waves that are not returned to earth. These waves are not used for terrestrial communications or broadcasting. Figure 3 also shows the difference between single-hop skip and multi-hop skip as a function of incident angle. While multi-hop signals offer greater distances, it is also generally true that a multi-hop transmission is more subject to fading, and weaker, than a single-hop transmission.

Wanna Watch an Eclipse on Your Radio?

There will be an annular solar eclipse in the USA on 10 May 1994. It will be the last such eclipse until 2017. An annular eclipse differs from a total eclipse because the perceived diameter of the moon as it blocks the sun's light is smaller than the solar disk, so the result is a "ring of fire" in the sky. Eclipses affect radio propagation for a brief period. The reason why ionospheric skip occurs is that ionization of the earth's upper atmosphere results from the bombardment of the sun's energy on it. That's why daytime and nighttime propagation are so different: During the day ionization levels are high, but after dark the levels drop off rapidly. During an eclipse, the region along the eclipse path thinks it's nighttime, so nighttime conditions appear.

Several different types of observation are open to the scientifically-minded amateur. Some simply involve monitoring the bands for changes in DX patterns. Others involve transmitting test signals and setting up networks of observers. My "Carr's Corner" column in *73 Amateur Radio Today* for October 1993 provides details. Also, if you want a bibliography of past articles that you can look up (mostly for the 1970, 1976 and 1979 eclipses), then send me a self-addressed stamped envelope (SASE) with two first-class stamps on it (I did your literature search for you). Alternatively, I've provided the biblio to *Radio Fun* and they can bang it onto their computer bulletin board (603-924-9343). Ham science teachers might want to use their radios to help students learn something of the physics of eclipses as they interact with earth's atmosphere.

Radio-literate science teachers might also want to learn about very low frequency monitoring of solar events and about natural signals called "whistlers." These events can be monitored with simple home-brew receivers. Also, the VLF radio stations can be monitored on ham receivers if a frequency converter is used ahead of the receiver. A 1991 book on VLF circuits, titled *The Low and Medium Frequency Radio Scrapbook*, 7th Edition, is available from its author, Ken Cornell W2IMB (225 Baltimore Avenue, Point Pleasant Beach NJ 08742). I paid $17.95 for the book from EEB (323 Mill Street N.E., Vienna VA 22180; 1-800-368-3270). Information on whistlers can be obtained from Mike Mideke (POB 123, San Simeon CA 93452). He offers *Whistler Hunter's Guide* for $6, and a narrated 60-minute cassette tape for $10 (the tape is invaluable for determining what you are hearing). RF

upgrade . . . don't stop now

by Gordon West WB6NOA

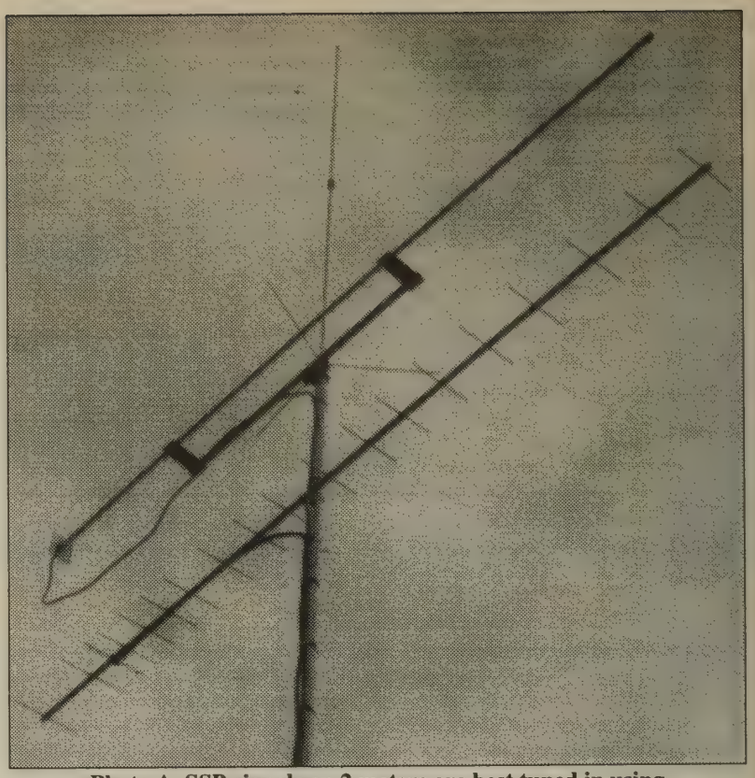


Photo A. SSB signals on 2 meters are best tuned in using horizontal polarization.

What's on 2 Meter SSB Anyway?

Your typical 2 meter hand-held and mobile transceivers operate in only one mode: frequency modulation, abbreviated FM. Other equipment may use phase modulation (PM) for transmit, but frequency modulation and phase modulation all sound about the same. PM emission occupies a narrow band of frequencies, typically plus-or-minus 5 kHz from the center frequency. You usually see this specification noted as "+/-5 kHz DEV," indicating the carrier deviates up to 5,000 cycles up and down from the resting frequency.

FM is great for local communication through repeaters and simplex communication over the VHF or UHF bands. But FM emissions suffer from phase distortion when the signal goes more than a couple hundred miles. Can you get 200 miles out of an FM set? Sure, try listening in on the space shuttle when the astronauts transmit down to us on 145.55 MHz.

There is a unique group of 2 meter operators who run "multimode" mobile and base transceivers. Besides FM, these sets may also tune in CW and single sideband. On 2 meters, single sideband is used for many long-range contacts:

Satellite reception and communications
Long-haul tropospheric ducting
Meteor burst communications
CW for moonbounce
SSB and CW for sporadic-E communications

Two meter single sideband activity is not compatible with FM. A 2 meter SSBer can't talk to an FMer, and an FMer can't talk to a station operating on 2 meters SSB. The two don't mix.

The frequencies from 145.80 MHz to 146.00 MHz are reserved exclusively for weak signal SSB satellite communications. Never run FM between 145.80 and 146.00 MHz! No FM here!

With an SSB multimode 2 meter transceiver, it's easy to tune in to orbiting satellites. Even a small ground plane can easily receive hams thousands of miles away chatting over the orbiting OSCARs. It takes multimode 2 meter SSB gear to tune them in. Just a simple ground plane is plenty for receive, and a relatively simple beam antenna lets everyone with a no-code Technician Class license and higher work off of the "birds."

Down around 144.20 MHz is the hangout for 2 meter SSB stations who are working direct over distances of up to 500 to 800 miles away. They use horizontal beam antennas, and with the right conditions they can talk for hours on the 2 meter band in excess of 500 miles away. Most 2 meter multimode operators use a 100 watt "brick," another name for that block amplifier that needs a 12 volt battery to keep it going. Although 100 watts output is handy, it's not absolutely necessary. I have worked many stations well over 400 miles away on my 25 watt Kenwood 751 multimode 2 meter transceiver "barefoot" (without an amplifier). A long boom beam, semi-rigid coax, and a hot transceiver is all that's necessary for extra-long range on 2 meter SSB.

And if you really get serious about your weak signal operation, you can plan ahead for meteor showers or the monthly moonbounce "window" that lets you hear signals literally out of this world. Most of this activity takes place below 144.10 MHz.

Since FM and weak signal 2 meter SSB is NOT compatible on the same frequency, never use your FM hand-held, mobile, or base transceiver below 144.30 MHz. Everything at the bottom of the 2 meter band below 144.30 has been band-planned for weak signal SSB or CW. No FM below 144.30 MHz!

If operating through 2 meter FM repeaters has lost its excitement, and it's no big deal to work FM across town on simplex, do consider a new or used 2 meter multimode transceiver for 2 meter SSB communications. It's a small, elite group down around 144.20, and an ever-growing fraternity of satellite operators up at 145.80 MHz, and you are encouraged to expand your operating skills by switching over to a mode that will let you literally work out of this world on sideband of CW or 2 meters. RF

MHz	Use
*144.00-144.05	EME (CW)
*144.05-144.06	Propagation beacons (old band plan)
*144.06-144.10	General CW and weak signals
*144.10-144.20	EME and weak-signal SSB
*144.20	National SSB calling frequency
*144.20-144.30	General SSB operation, upper sideband
*144.275-144.300	New beacon band
*144.30-144.50	New OSCAR subband plus simplex
144.50-144.60	Linear translator inputs
144.60-144.90	FM repeater inputs
144.90-145.10	Weak signal and FM simplex
145.10-145.20	Linear translator outputs plus packet
145.20-145.50	FM repeater outputs
145.50-145.80	Miscellaneous and experimental modes
*145.80-146.00	OSCAR subband—satellite use only!
146.01-147.37	Repeater inputs
146.40-146.58	Simplex
146.61-146.97	Repeater outputs
147.00-147.39	Repeater outputs
147.42-147.57	Simplex
147.60-147.99	Repeater inputs

Table 1. 2 meter band plan with "*" denoting CW-and-SSB-only areas of operation.

what's next?

by Carole Perry WB2MGP

Photo A. Debbie Siegel N2SIJ.

From the Mouths of Babes

One of the nice things about having many friends and acquaintances through ham radio is that I also get to meet the offspring or "harmonics" of these folks. Because I teach an amateur radio program to over 400 kids every term at a local intermediate school, I get to have many of the children of ham radio friends in my classes. It's always fun to rise to the challenge of motivating these youngsters to get licensed after their dads have tried every trick in the book to get them interested in ham radio.

One exception to the "frustrated-ham-radio-dad" club is Mike Siegel WB2FCP. Mike has been a staunch supporter of my radio efforts at Intermediate School 72 in Staten Island for many years. We first met when Mike volunteered to help out with our SSTV contact with the *Challenger* space shuttle on August 1, 1985. Since that time, Mike has come to my school to talk with my ham radio classes and to share his interesting background with the children. Mike is an engineer at ABC television studios who has won an Emmy for his work with computer video graphics.

Mike is a ham who is worthy of having a column written all about him, but this month's *Radio Fun* "What's Next?" column is going to focus on Mike's young daughter, Debbie. Debbie wasn't in my class, but she did do a wonderful job speaking to my class one morning in June as she conducted a 2 meter demo from her own school. Children always enjoy speaking with other kids on the radio. Never underestimate the importance of peer group influence with young people!

Debbie is N2SIJ. She obtained her Novice license in 1991 when she was just eight years old. Mike tells me that her original motivation for getting a ham radio license was to be able to speak with her dad as he traveled home from work every day. Debbie found it difficult to get the Novice license as she struggled with the theory. Interestingly, though, she enjoyed the code and found it to be fun.

At the end of July 1992 she obtained her HF/Technician license and was finally able to speak with her father as he made his daily commute home each afternoon. When working with young people in ham radio, it is important to show the practical use of what they are studying for. Talking to other kids at the mall or at sporting events, or being able to speak with a parent on a 2 meter rig is a great motivator!

When Debbie decided to do a major project on ham radio for her fourth-grade class, she enlisted Mike's help. He suggested that she get a higher license before doing the project. Debbie's words were, "Sure, let's do it."

In August 1992, Debbie passed the written portion of her General license. Now the push for the CW speed was in order. Starting that September, at approximately 5 words per minute, she was taught all the character sounds at 20 wpm until she could recognize all the characters sent at 20 wpm with 5 wpm spacing. Slowly and very steadily the spacing was shortened to yield 20 wpm by mid-December. She practiced daily for a test session to be taken in early February of 1993. By that time, her code speed was in excess of 27 wpm and she had no problem in passing her 20 wpm code test. This gave her an upgrade to General with a CSCE for the 20 wpm of the Extra Class test.

After a few weeks of some well-deserved rest, Debbie started to study for the Advanced written test, which she passed on May 15, 1993. The very next day Mike asked her when she wanted to take the Extra license written exam. He never expected to hear her say, "I want to get my Extra Class license while I'm still nine years old and before I present my project to my class in June."

Mike figured he would need six weeks to go over the written material for the Extra exam. But Debbie insisted on aiming for the test session on June 7th, which would mean three weeks of study time, not six. A study routine was set up that required one and a half to two hours a day of studying, with double that on the weekend. On June 7th, at the tender age of nine years old, Debra Siegel passed her Extra Class written exam with a perfect score.

The following week, Debbie presented her ham radio project to her fourth-grade class and announced proudly to her classmates that she had made it to the top. During that presentation, Debbie called her dad on a local repeater and then gave a live demonstration with the children in my ham radio classes to her classmates and teacher. The sixth-, seventh- and eighth-graders at my end really enjoyed participating in the demo. "School-to-school" radio contacts are always terrific for kids. That's the whole premise of the "CQ All Schools" net every Tuesday and Thursday at 17:30 UTC (16:30 UTC winter time), on 28.303 MHz.

Debbie is an excellent student. She has been a member of a competitive dance group and studies jazz and tap dancing. Most of all, as her dad points out, "she's still a little girl." Even though she really likes ham radio and has a good station, one of her favorite pastimes is playing with her doll collection.

Debbie is the youngest member of an all-ham family. Her mother Elaine N2GET and brother Jeff N2IPU are both HF/Technicians. Mike WB2FCP is an Extra with over 30 years of ham radio experience. Needless to say, they are all proud of Debbie's performance. RF

activities calendar

Send your announcements to: Radio Fun Activities Calendar, 70 Route 202-N, Peterborough NH 03458. We'll print as many as space allows, on a "first come-first listed" basis.

OCT 2-3

VIRGINIA BEACH, VA Tidewater Radio Conventions, Inc., will present their 18th annual Virginia Beach Hamfest and Computer Fair/ARRL Virginia State Convention/Popular Communications SWL Convention, at the Virginia Beach Pavilion from 9 AM-5 PM Sat., and 9 AM-4 PM Sun. Speakers are Gordon West WB6NOA, and Roy Neal K6DUE. VE Exams, Flea Market, Tailgating, Forums, and more. Talk-in on 146.97. Order tickets (with SASE) from *Manny Steiner K4DOR, 3512 Olympia Ln., Virginia Beach VA 23452. Tel. (804) 340-6105.* Get Commercial info from *Lewis Steingold W4BLO, 1008 Crabbers Cove Ln., Virginia Beach, VA 23452. Tel. (804) 486-3800.*

OCT 3

ASHLAND, OH The North Central Ohio Hamfest will be held from 8 AM-3 PM at Ashland County Fairgrounds. Flea Market. Forums. 2m Foxhunt. Talk-in on 147.105+. Contact *Wally Green, 3 East Liberty St., Ashland OH 44805. Tel. (419) 281-3903.*

WARRINGTON, PA The Mt. Airy VHF Radio Club, Inc., (Pack Rats) will sponsor their Hamarama at the Rt. 611 Drive In. Talk-in on 146.52 (simplex). Gates open at 7 AM. Set-up at 6 AM. Contact *K3EOD, (215) 742-3312.*

OCT 8-9

AUGUSTA, GA The ARC of Augusta will sponsor a Special Event at the Augusta College Sports Complex, 3109 Wrightsboro Rd., from 6 PM-9 PM Fri.; 8 AM-5 PM Sat. Flea Market. VE Exams. Forums. Demos. Talk-in on 144.89/145.49, alt. 144.51/145.11. For tickets, tables, send check and SASE to *ARC of Augusta, P.O. Box 3072, Augusta GA 30914-3072.* For info, call *Ed Butorajac KM4QQ, (706) 798-1918.*

OCT 9

BELTON, TX Ham Expo '93 will be held by the Temple ARC, at the Expo Center in Belton, from 7 AM-2 PM. VE Exams. Free Test Bench. Transmitter Hunt. Call *Eric N5WFU, (817) 986-1257* or *Mike WA5EQQ, (817) 773-4768.* Write to *Temple ARC, 2014 S. 53rd, Temple TX 76504.*

LIMA, OH The Northwest Ohio ARC will host a Hamfest at the Allen County Fairgrounds. Contact *WB8BND, P.O. Box 211, Lima OH 45802.* VE Exams; pre-register with completed 610 and fee of $5.60 to *ARRL-VEC, W8TY, 1370 N. Stevick Rd., Lima OH 45807.*

TEANECK, NJ The Bergen ARA will hold its annual Fall Hamfest from 8 AM-2 PM at Fairleigh Dickinson Univ. Contact *Jim Joyce K2ZO, (201) 664-6725, before 10 PM.* FCC VE Exams; contact *BARA VE Hotline, (201) 797-0151 before 10 PM.* Talk-in on 146.190/.790 and 145.620 simplex.

TITUSVILLE, FL A Hamfest will be held at Sandpoint Park from 9 AM-5 PM, by the Titusville ARC. Advance registration is required. Contact *John Lowe KE4BBC, (407) 267-2000,* or *Bud Hughes K4CWG, (407) 267-3450.* Talk-in on 146.910 (-600 kHz).

OCT 9-10

EL PASO, TX The annual Internat'l Hamfiesta will be held at the Texas Nat'l Guard Bldg., 9100 Gateway Blvd., North. Sat. from 8 AM-5 PM; Sun. 8 AM-3 PM. Seminars. QCWA Breakfast. VE Exams both days. Talk-in on 146.88. Contact *Milly Wise W5OVH, P.O. Box 31628, El Paso TX 79931. Tel. (915) 751-4160.*

MEMPHIS, TN MemFest '93 Greater Memphis Amateur Radio and Computer Show, will be held at Shelby Farms Show Place Arena, 105 Germantown Road So., by the Mid-South ARA. Time: Sat. 9 AM-4 PM; Sun. 9 AM-2 PM. VE Exams both days, 9 AM-Noon. Flea Market Info: *Steve Cheeseman NX3W, 3290 New Getwell Suite 202, Memphis TN 38118. Tel. (901) 365-6621 (W); (901) 368-6781 (H).* General and Exhibitor Info: *Nita Wofford N4DON, 2966 Cordell, Memphis TN 38118. Tel. (901) 363-4971.*

OCT 10

DURHAM, CT The Meriden ARC, the Middlesex ARS, and the Shoreline ARC, will jointly sponsor the "Nutmeg Hamfest" at the Fairgrounds in Durham. VE Exams. Talk-in on 147.96/.36. Contact *Jim McCandless N1IZF, (203) 349-3353, 6 PM-10 PM; packet: N1IZF @ W1NRG.CT.USA.NOAM. Mail: P.O. Box 193, Durham CT 06422.*

WALL TOWNSHIP, NJ The 6th annual Shore Area Ham and Computerfest, sponsored jointly by the Jersey Shore ARA (JSARS), Neptune ARA, Ocean-Monmouth ARC (OMARC), and Garden State ARA (GSARA), will be held at the Allaire Airport. Doors open 0800-1600. VE Exams. Talk-in on 145.110 (NK2O) for cars; UNICOM 123.00 MHz for aircraft. Get details from *Al Jackson NK2O, (908) 922-8121.* For tables/tickets, write to *Shore Area Hamfest, P.O. Box 635, Eatontown NJ 07724-0635.*

WAUKESHA, WI The Kettle Moraine RAC Inc., will hold its 15th annual Ham and Computer Swapfest at the Waukesha County Exposition Center, Hwys J & FT. Doors open 8 AM-1 PM. VE Exams by the Badger Examiners. Advance tickets $4; 4' tables $5; send a SASE and check payable to *KMRA Swapfest, P.O. Box 411, Waukesha WI 53187-0411.*

OCT 16

FRANKLIN, PA The Fort Venango Mike & Key Club will hold a Ham Auction/Flea Market at the Venango County 4-H Fairgrounds, RT # 62, starting at 8 AM. Auction begins at 10 AM. Talk-in on 147.12+, 145.23-, and 145.19- MHz. Contact *Jerry Almes W3DTW, (814) 432-3647,* or *Bruno Wolozyn K3MHB, (814) 677-8694.* Or write to *The Ft. Venango Mike & Key Club, RD #1, P.O. Box 591, Cranberry PA 16319.*

GRAND FORKS, ND Forx ARC will sponsor a Hamfest at Grand Forks Civic Auditorium, 615-1 Ave. N., beginning at 8 AM. VE Exams at 10 AM, walk-ins welcome. Talk-in on 146.94. Contact *Bob Smith ND1H, 1203 Shakespeare Rd., Grand Forks ND. Tel. (701) 746-9498.*

GRAY, TN The 13th annual Tri-Cities Hamfest will be held at the Appalachian Fair Grounds, located off I-181 in Gray. Flea Market. Sponsors: Kingsport, Bristol, and Johnson City Radio Clubs. Mail inquiries to *Tri-Cities Hamfest, P.O. Box 3682 CRS, Johnson City TN 37602.*

SANFORD, NC A Fall Festival will be held from 8 AM-4 PM by the Central Carolina ARS. Location: Lions Club Fairgrounds, 7th & Weatherspoon Sts. Contact *April Maggart KD4QMU, 8512 Deep River Rd., Sanford NC 27330.*

STARKE, FL Bradford County Fairgrounds, US 301 North of Starke, will be the location for the 3rd annual Starke Hamfest, sponsored by the ARC - Bradford Area. Time: 0800-1600 hrs. Talk-in on 145.150- and 146.520 simplex. Contact *Donna KC4MXK, (904) 964-9491,* or *Tony WB2FGL, (904) 964-9328.* For reservations, make check payable to *ARC - Bradford Area, c/o Tony Spatafore WB2FGL, P.O. Box 852, Starke FL 32091.*

OCT 17

CAMBRIDGE, MA A Tailgate Electronics, Computer and Amateur Radio Flea Market will be held from 9 AM-2 PM at Albany and Main Sts. Call *(617) 253-3776.* Mail reservations before Oct. 5th to *W1GSL, P.O. Box 82 MIT BR., Cambridge MA 02139.* Sponsors: MIT Radio Soc., and the Harvard Wireless Club. Talk-in on 146.52 and 449.725/444.725 pl 2A W1XM/R.

CENTRALIA, IL The Centralia Wireless Assn., Inc., will hold its annual Hamfest at the Kaskaskia College Gym, 3 mi. NW of Centralia. Doors open at 8 AM. Talk-in on 147.27/.87 and 443.2/448.2. VE Exams at 11 AM, walk-ins accepted. Contact *Bud King WA9U, (618) 532-6606.* Mail ticket orders with an SASE to *Centralia Wireless Assn., Inc., Hamfest Tickets, P.O. Box 1166, Centralia IL 62801.*

MILAN, OH The firelands Area Repeater Assn. will hold their 2nd annual Hamfest at the Ehove Career Center, from 8 AM-4 PM. Talk-in on WB8LLY Rptr. 146.805. Contact *Carol Richards AI8V, (419) 433-6624.*

TUCSON, AZ The 5th annual Tucson Hamfest, sponsored by Old Pueblo RC, ARRL, ARCA, will be held from 7 AM-1 PM at DeAnza Drive-In, 22nd St. & Alvernon Way. Talk-in on 146.22/.82, 146.28/.88, and 146.52 simplex. Contact *A.J. Pawlowski KB7KZ, 3418 W. Green Trees Dr., Tucson AZ 85741. Tel. (602) 742-2605*

OCT 23

GRANDVIEW, MO The Southside ARC will hold its annual Octoberfest at the Grandview Middle School, 12650 Manchester St., from 8 AM-2 PM. VE Exams. Talk-in on 147.12+. Contact *Southside ARC, P.O. Box 1142, Grandview MO 64030,* ot *Marvin Munson WD0GHN, (816) 761-3238.*

SUMTER, SC The Sumter ARA will present their 7th annual Hamfest and South Carolina's 1993 ARRL Convention, from 8 AM-4 PM at Sumter County Exhibition Center, 700 W. Liberty St. VE Exams for Walk-ins Only. For VE Exam info, call *Dan Mask WB5SGH, (803) 775-9106.* Dealers, call *Hap Griffin WA4UMU, (803) 469-6381.* For written info, write to *S.A.R.A. - Hamfest, P.O. Box 193, Sumter SC 29150.*

OCT 23-24

CHATTANOOGA, TN The Hamfest Chattanooga Amateur Radio & Computer Convention will be sponsored by the Chattanooga ARC, Sat. 9 AM-5 PM; Sun. 9 AM-3 PM. Talk-in on 146.19/.79. General info contact *Charles E. Curle AD4F, 8719 Snow Hill Rd., Ooltewah TN 37363.* Dealer info/reservations: *Barbarra Gregory, 8619 Smokerise Ln., Chattanooga TN 37421. Tel. (nights) (615) 892-8889.* Flea Market info: *Lou Carter, 107 South Bragg Ave., Lookout Mountain TN 37350. Tel. (nights) (615) 821-4043.*

MOBILE, AL The Mobile ARC will hold a Ham and Computer Fest at Abba Shrine Temple, 7700 Hitt Rd., off Shillinger Rd. Time: Sat. 8 AM-4 PM; Sun. 8 AM-3 PM. VE Exams both days at 9 AM. Contact *Louis AC4EN.* Talk-in on 146.82/.22. Rag-Chew 149.94/.34. For details, call *Richard Ireland KD4TTD, (205) 824-2749,* or write *M.A.R.C., P.O. Box 81791, Mobile AL 36689.*

PALM BEACH, FL The West Palm Beach ARC will sponsor their 1st annual High Speed CW Contest, beginning at 1 PM at the Palm Beach County Fairgrounds. For details, contact *Ted Herrman AE8G, 301 North M St., Lake Worth FL 33460. Tel. (407) 586-7940; FAX (407) 585-3466.*

OCT 24

GOLDEN, CO The Rocky Mountain Radio League, Inc., will present the 1993 RMRL Hamfest from 8 AM-2 PM at Jefferson County Fairgrounds, 15200 W. 6th Ave. VE Exams. ARRL Forum. Talk-in on 144.62/145.22 MHz. Contact *Joe Dickinson WT0C, (303) 795-3397.*

WARREN, MI The Utica Shelby Emergency Comm. Assn. will hold their USECA Swap from 8 AM-2 PM, at Student Community Center (K-Bldg.), Macomb Community College, South Campus. VE Exams (pre-registration required) call *Bill N8CVC, (313) 468-8345.* Table info: *Dave N8OEV, (313) 792-0791;* or *Virginia N8NLS, (313) 268-0691.* Talk-in on 147.18+, 147.42 simplex. For Club info, call *Dave KF8CT, (313) 268-6730.* Mail pre-registration payments with an SASE to *Virginia Przekaka N8NLS, 34473 Coachwood, Sterling Hts MI 48312.*

WESTMINSTER, MD The Radio Clubs of Carroll County MD and Penn-Mar PA, will be holding the 4th annual Mason-Dixon Computer & Hamfest at the Carroll County Ag Center, starting at 8 AM. VE Exam registration begins at 8 AM; pre-registration requested; contact *Page Evans NE3P, (717) 359-7610.*

OCT 30

EAST LYME, CT The Tri-City ARC will hold its annual Fall Auction at the Senior Citizens Center, Waterford Municipal Complex, from 10 AM till sold out. Bring your equipment to be auctioned. Talk-in on 146.07/.67 Rptr. For info call *KA1BB at (203) 739-8016.*

FREDERICKSBURG, VA VE Exams will be given at the Rappahannock Library in Fredericksburg. For details, call *AC4SK at (703) 373-7076,* or *AC4MB at (703) 891-5581.*

ST. PAUL, MN The Hamfest Minnesota & Computer Expo, sponsored by the Twin Cities FM Club, will be held in the Main Arena at the St. Paul Civic Center, 143 West 4th St.: Flea Market. VE Exams. Educational and Fun Seminars. Talk-in on 146.16/.76 Rptr. For info, write to *Twin Cities FM Club, P.O. Box 5598, Hopkins MI 55343*, or call the *Hamfest Minnesota Info Line, (612) 535-0637*.

OCT 31

LEBANON, IN The Boone & Clinton County ARCs will co-sponsor a Hamfest from 8 AM-4 PM at the Boone County 4-H Fairgrounds. Warm & Dry Community Bldg. Flea Market. VE Exams near by. Talk-in on 147.105 and 443.150. Contact *Tim French KA9WDJ, (317) 324-2618; Don Jackman N9ILX, (317) 482-5211*; or *Don Lecklitner N9GBO, (317) 654-6580*. Or write to *Boone County ARC, P.O. Box 186, Lebanon IN 46052*.

MARION, OH The Marion ARC will present its 19th annual "Heart of Ohio Hamfiesta and Computer Show" at the Marion County Fairgrounds Coliseum, from 8 AM-3 PM. Talk-in on 147.90/.30 Rptr. Contact *Steve Eckard WS8S, 6583 South St. Meeker, Marion OH 43302. Tel. (614) 499-3565*.

NOV 6

CARTHAGE, MO The Carthage AR Soc. Hamfest will be held at the Carthage Memorial Hall at the intersection of Oak & Garrison Sts., from 8 AM-1 PM. Talk-in on 147.42 simplex. Contact *Jim Dixon WX0J*, or write to *Carthage ARC, P.O. Box 783, Carthage MO 64836. Tel. (417) 358-4126*.

COOKEVILLE, TN The Cookeville Rptr. Assn. and The Tennesee Tech ARS will co-sponsor the 3rd annual Cookeville Hamfest at Hooper Eblen Center on the campus of TTU. Time: 8 AM-4 PM. Talk-in on 147.21+. VE Exams at 10 AM. Contact *Rich KD4ABC, (615) 528-7171* or *TTARS, WA4UCE, TTU Box 5262, Cookeville TN 38505. Tel. (615) 372-3043*.

ENID, OK Hoover Bldg., Garfield County Fairgrounds at Oxford St. and N. 4th, is the location for a Hamfest being sponsored by the Enid ARC. VE Exams at 10 AM (walk-ins welcome). Talk-in on 145.29/144.69. Contact *Fred N5QJX, (405) 242-3551*, or *Tom N5LWT, (405) 233-8473*.

EUSTIS, FL The Lake AR Assn. will hold their annual Hamfest and Electronics Expo at the Lake County Fairgrounds from 9 AM-5 PM. W5YI Testing for all classes, starting at 1 PM. Radio and ATV Demos. Contact *Cole A. Ruck KC4UIG, (407) 273-1624 (eves)*; or *Pat Paris WD4LXN, (904) 669-7279 (eves)*.

FERNDALE, WA The Washington Mt. Baker ARC Flea Market will be held from 9 AM-4 PM at Ferndale Band Boosters Bingo Hall, NW corner of Interstate 5 and Smith Rd. overpass. VE Exams. Contact *Terry Andrew VE7BUS/W7, 1009 Glenning St., Lynden WA 98264. Tel. (206) 354-5868*.

MILWAUKEE, WI The Milwaukee Repeater Club will sponsor the 9th annual "6.91 Friendly Fest" from 8 AM-Noon at St. John the Evangelist Congregation, 8500 W. Cold Spring Rd. Talk-in on 146.91- and on 146.52. VE Exams. Contact *The Milwaukee Repeater Club, P.O. Box 2123, Milwaukee WI 53201*. Reservation deadline Oct. 28th.

NOV 6-7

LONG ISLAND, NY "HamExpo '93 Weekend" and ARRL Section Convention, sponsored by the Radio Central ARC, will be held at Suffolk Community College from 9 AM-4 PM. Flea Market. Computer Show. VE Exams, and more. Group hotel rates. Talk-in on 145.150-4Z or 449.525-2A. Contact *Valerie DeRicco N2NYB, (516) 874-3669* or *John Mark KB2QQ, (516) 689-6343*.

SPECIAL EVENT STATIONS

OCT 2

ALAMOGORDO, NM The Alamogordo ARC will conduct their 3rd Special Event operation, sponsored by the International Space Hall of Fame, to honor new inductees. Station WA5IPS will operate from atop the Space Hall. Frequencies: SSB - 28.480/.490 MHz from 1600-1800 UTC: General phone bands on 15 and 20 meters from 1800-2300 UTC. We will operate in the 20 meter phone band if propagation is poor. Special QSLs will be sent from the Space Hall of Fame and will be certified by A.A.R.C. members. Mail QSL requests to *International Space Hall of Fame, Route 2001 - P.O. Box 533, Alamogordo NM 88311-0533*. SWL requests will be honored.

MATOON, IL The Moultrie ARC will operate W9BIL to commemorate the annual Chocolate Harvest Celebration. Operation will be in the General 40, 20, and 15 meter bands, and the Novice 10 meter subband. For a certificate, send QSL and a SASE to *Bryon Abrams KB9BWS, P.O. Box 242, Findlay IL 62534-0240*.

RICHARDSON, TX The Alcatel ARA will operate Station N5TBQ (Texas Best Quality) 1500Z-2100Z, from the Open House site of Alcatel Network Systems, Inc. Operation will be in the General phone portions of 40, 20, 15, and 10 meters. For a unique QSL card, send contact report to *Alcatel Network Systems, Inc., AARA, M/S 401-212, 1225 North Alma Rd., Richardson TX 75081-2206*.

OCT 6-10

HILLSBOROUGH, NC The Orange County Radio Amateurs will commemorate the bicentennial of the founding of the Univ. of North Carolina at Chapel Hill. SE Stations will operate, with a /UNC suffix, on the lower 25 kHz of the General portions of the 80, 40, 20, and 15 meter bands SSB, from 2300Z-0300Z on Oct. 6-8. In addition to the above band segments, SSB operation on the lower 50 kHz of the Novice portion of 10 meters (propagation allowing), will take place Oct. 9-10, from 1200Z-0000Z. An 8 1/2" x 11" certificate will be endorsed for all bands worked, with a special endorsement for UNC graduates. For a certificate, mail an SASE to *David J. Snyder N2MLU, 600 S. Churton St., Apt. #66, Hillsborough NC 27278*.

OCT 9-10

CAMANO ISLAND, WA The 3rd annual "Slug, Oyster and DX Festival" honors our friends the Mollusks, and is sponsored by the West Seattle ARC (W7AW). Operation will be Oct. 9 1500-0400 UTC to Oct. 10, 1500-2100 UTC. Frequencies: 21.052 MHz CW, 14.235 MHz SSB, 7.045 MHZ CW, 3.930 MHz SSB. For a colorful certificate showing a slug and oyster at play, send your QSL and a large SASE to *West Seattle ARC, c/o F. Tate, 10230 4th Ave. SW, Seattle WA 98146*.

SAN GABRIEL MTNS., SO. CA The 3rd annual "Mountain Top Mobile" will operate from Table Mountain, to celebrate radio for radio's sake. Operators: KC6TAZ, N6XOG, N6RNX, KM6TJ and N6PQB. QSL via individual operators (call followed by "Mountain Top Mobile").

TORRANCE, CA The South Bay ARC will operate KN6JN 1700Z-2400Z from the 2nd annual Torrance Air Fair in So. CA. Operations will be on General phone portions of 15 and 20 meters and Novice portion of 10 meters; also on 145.77 simplex and 224.38 rptr. For a certificate, send QSL and 9" x 12" SASE to *SBARC, P.O. Box 536, Torrance CA 90508*.

OCT 15-16

ST. LAWRENCE COUNTY, NY The North Country ARC will operate N2PSL to commemorate the Founding of the NCARC. Operation will be in the lower 25 kHz of the General portion of 80, 40, 20 meters, and the 10 meter Novice subband. For a QSL, send QSL and SASE to *NCARC, c/o Pete Baltradis N2IJW, Rt. 1 Box 206, Norwood NY 13668 USA*.

OCT 15-17

UNION, KY The Northern Kentucky ARC will operate K4CO 1400Z-2200Z from Big Bone Lick State Park, in conjunction with the annual Salt Festival. Operation will be on 40, 20, and 10 meters; also, 146.375+ Rptr. For a certificate, send 4" x 9" SASE and contact number to *NKARC, P.O. Box 1062, Covington KY 41012-1062*.

OCT 16

SAN BERNADINO, CA The Citrus Belt ARC will be operating Station W6JBT from the Patton State Hosp., to commemorate the admission of the first patient to the hospital 100 years ago. Operation will be from 1500 UTC Oct. 16th-1500 UTC Oct. 17th. Frequencies: Phone - 7.270, 14.270, 21.350, 28.350; 145.850 144-148 MHz band; 224.860 222-225 MHz band. For a certificate, send QSL and a 9" x 12" SASE to *Citrus Belt ARC, P.O. Box 3788, San Bernardino CA 92413-3788*.

SANTA ROSA ISLAND, FL The Serious Hams ARC will operate N4MAD from Ft. Pickens State Park 1200Z-2000Z on 40, 20, 15, and 10 meters in the CW and voice portions of the bands, near the lower edge of the General portion of each band. Santa Rosa Island is IOTA-142. For a special QSL, send SASE and contact number to *AD4BU, 10697 Bridge Creek Dr., Pensacola FL 32506*.

OCT 16-17

DETROIT, MI The Wayne County ARPSC will operate WY3Q/8 from 1400Z Oct. 16-2200Z Oct. 17, to commemorate the 16th annual running of the Detroit Free Press/Mazda Internat'l Marathon. Operation will be in the General 80-15 meter phone subbands and the Novice phone subbands on 10 meters. For a QSL card, send QSL and SASE to *Bill Gilbert, 222 Cleveland, Trenton MI 48183*.

OCT 16-23

FORT WORTH, TX The Menasco ARC will be on the air as a special event Station celebrating Menasco Aerosystems' 37 years of operating in the State of Texas. Operation will be at 28.425 and 21.060 or 21.125 plus or minus QRM. To receive a special 8 1/2" x 11" certificate, send a large SASE to the control operator.

OCT 20-22

NEW YORK CITY, NY The "22 Crew" will operate WB2JKJ from the HQ of the Radio Club of Junior HS 22, to celebrate the 13th Anniversary of NYC's largest Ham Club and EDUCOM (Education Thru Communication). Join them on 7.238 MHz. from 1200-1300 UTC, then on to 21.395 till 2000 UTC, Oct. 20-22. For an outrageous QSL and surprise package, write to *RC of JHS 22, P.O. Box 1052, New York, NY 10002*, or FAX to *(516) 674-9600*.

OCT 23

EDISON, NJ The Piscataway ARC will operate Station AA2KS 1300Z-2200Z, to celebrate Edison's discovery of the electric light bulb. Operation will be on the General portion of 40, 20, 15 meters and Novice 10 meters. For a special QSL card send QSL and SASE to *Piscataway ARC, P.O. Box 1233, Piscataway NJ 08854*.

OCT 23-24

RIVERSIDE, CA The Moreno Valley ARA, Team March ARC, and the March Air Force Base MARS station will operate KI6GD during the March AFB Open House. Operations will be 1600Z-2200Z both days, on the General CW and phone sub-bands of 40, 20, and 15 meters. Also the Novice section of 10 meters. For a special certificate, send $100 and contact number to *MVARA, P.O. Box 7642, Moreno Valley CA 92552*. For more info, contact *MVARA or packet N6YIH@N6YIH.#soca.ca.usa.na*.

OCT 30

ACCOMACK COUNTY, VA The OH-KY-IN ARS will activate an IOTA during the CQ WW contest. The operation will be on all bands. The ITA will be one of the offshore islands in Virginia. Activity during the contest will be from Chincoteague Island, NA83. On Oct. 28 there will be a one day operation from Asateague Island, NA139. The call used will be K8SCH/4. The QSL route for both will be *John Hugentober, Sr. N8FU, 4441 Andreas Ave., Cincinnati OH 45211*. Please enclose an SASE.

OCT 30-31

RIVERSIDE, CA Moreno Valley ARA, Team March ARC, and the March Air Force Base MARS station will operate KI6GD during the March AFB Open House. Operations will be 1600Z-2200Z both days, on the lower 25 kHz of the General subbands and Novice 10 meters. Operations will be SSB phone and CW; plus 145.560s and 146.655R pl 103.5. For a special USAF Certificate, send QSL and $1.00 to *MVARA, P.O. Box 7642, Moreno Valley CA 92552*.

OCT 31-NOV 1

BREVARD, NC The Transylvania County ARC will operate W4ZCB to celebrate Halloween from the Devil's Courthouse in Transylvania County. Operation will be from 2000Z Oct. 31-0200Z Nov. 1. Frequencies: 7.234, 14.295, 21.365, 28.335 SSB, and 146.52 FM simplex. For a certificate, send a legal size or 9" x 12" SASE to *Harold Johnson W4ZCB, 115 Kindy Forest Dr., Hendersonville NC 28739*. RF

Radio Fun flea market

Turn your old ham and computer gear into cash now. Sure, you can wait for a ham-fest to try and dump it, but you know you'll get a far more realistic price if you have it out where 30,000 active ham potential buyers can see it, rather than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar, and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *Radio Fun Flea Market* costs you peanuts (almost)—comes to 25 cents a word for individual (noncommercial) ads, and 80 cents a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad. This is a monthly magazine, not a daily newspaper, so figure a couple of months before the action starts; then be prepared. If you get too many calls, you priced it too low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right, and julybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using.

Send your ads and payment to *Radio Fun Flea Market*, Judy Walker, 70 Route 202 N, Peterborough NH 03458, and *get set for the phone calls.*

The Deadline for the November 1993 Flea Market is September 22, 1993.

HELP WANTED—EMPLOYMENT OPPORTUNITY AT *RADIO FUN*. The Publisher of this magazine is currently accepting resumes for the following position.

ADVERTISING SALES REPRESENTATIVE—Display advertising sales for the only magazine devoted to newcomers in the amateur radio hobby. Intensive customer contact over the telephone, with an emphasis on developing new accounts. Must be available for weekend travel approximately six times per year. An amateur radio license, while helpful, is not necessary. Salary Range: teens, plus commissions.

To be considered for this position, send (no phone calls) your resume and cover letter to: **MR. D. CASSIDY, WGI,** 70 Route 202 North, Peterborough NH 03458. RF198

SENSATIONAL NEW WAY TO LEARN CODE-Do Aerobics, Sing, Jog, or **Drive** while learning code! **Now** the secret is yours! Order **THE RHYTHM OF THE CODE-Morse** code music cassette today! $9.95 ppd **KAWA RECORDS**, P.O. Box 319-R, Weymouth MA 02188. The **HIT** of the 1993 Dayton Hamvention! RF247

MINIATURE POLICE RADAR TRANSMITTER one mile range, $41 assembled, $31 kit, (219)489-1711. P.O. Box 80096, Fort Wayne IN 46898. RF251

AMIGA, MACINTOSH, ATARI XL/XE/ST Amateur Radio PD Software $4.00 disk. Two-stamp SASE brings catalog. Specify computer! **KINETIC DESIGNS HAMWARE** Box 1646, Orange Park FL 32067-1646. RF266

HOMEBREW COMPONENTS. Large SASE brings catalog. **KA7QJY COMPONENTS**, Box 3893, Logan UT 84323 RF271

WANTED: 4 pin tubes 211/VTA4C, 845, 2A3, etc. Garrard 301, 401, **SME RMA**, 309, 3012 Arms Ortofon SPU. Oil Caps. Call (201)751-5959. Paul Gil, 180 Union Ave., Belleville NJ 07109. RF320

IBM SHAREWARE! Huge selection! $1.00 Disk! $.35 Specials! Catalog $1.00. **PMA-RF**, Box 2424, Scottsdale AZ 85252. RF360

SATELLITE EQUIPMENT WHOLESALE. Drake IRD's, start $494.00; Toshiba IRD's, start $494.00; IRD, LNB, FEED, ACTUATOR, $633.00; LNB's, $59.00; Actuators, $59.00; VCRS Modules, $389.00. Large inventory. **SATELLITE WAREHOUSE**, PO Box 85601, Tucson AZ 85754-5601. Orders, (800)851-6534; Fax, (602)624-1629; Info, (602)623-5748. RF380

MILITARY RADIO EQUIPMENT WANTED PP32T/GRC9 A.C. Power Supply; AA-18 Alimentation Power Supply; Microphone SW-109; RT70/GRC; AM65; PP281; AB-86 Antenna Mast; PP-1104/G Power Supply; AN/URM-48 Sig Gen; Antenna Mounts M652/GR. **KA1ZQR**, 348 N. Main St., Stonington CT 06378, (203)535-1286. RF390

BROWNIES QSL CARDS since 1939. Catalog and Samples $1 (refundable with order). 3035 Lehigh Street, Allentown PA 18103. RF475

KIT BUILDERS! Complete list of 150 + kit vendors. SASE + $3 USD to: **RUTENBER ENGINEERING**, 38045 10th St. E. #H75-AR, Palmdale CA 93550. RF485

PASS THE NO CODE TEST. "Easy Method." Send $4 and SASE to **L.W. SERVICE,** P.O. Box 91, Hillside NJ 07205-2702. RF500

INEXPENSIVE HAM EQUIPMENT. Send stamp for list. **WA4DSO**, 3037 Audrey Drive, Gastonia NC 28054. RF559

LICENSE PLATE HOLDERS (Chrome or Black) with message plates. Your name and call letters engraved. Designed mail box plate 12 1/2" X 4 1/4" black. Name and Number engraved. Chrome or black license plate holder, $10.50; mail box plate, $12.50. Each order S&H, $2.50. **N.E. MARION ENGRAVING**, R.F.D. 2, Box 360, Peterborough NH 03458. RF590

PRINTED CIRCUIT BOARDS for projects in *73, Ham Radio, QST, ARRL Handbook.* List, SASE. **FAR CIRCUITS,** 18N640 Field Ct., Dundee IL 60118. RF595

VIDEO SYNC GENERATOR Restores horizontal & vertical sync lines from distorted analogue video formats. For information on completed units & pricing, write: **R.C. DISTRIBUTING,** Box 552, South Bend IN 46624. Phone: (219)236-5776 RF610

WANTED: BUY & SELL All types of Electron Tubes. Call (612)429-9397, Fax (612)429-0929. **C & N ELECTRONICS,** Harold Bramstedt, 6104 Egg Lake Road, Hugo MN 55038. RF620

INTERESTED IN PUBLIC SERVICE? Join REACT TODAY! For information write, **KA3PDQ, c/o REACT,** P.O. Box 8797, Allentown PA 18105. RF630

DO YOU WANT TO EASILY GET $30? Send me the name and the address of the company that built color lamps to be installed under cars. Francesco Fontana, via Salerno 11, 35142 Padova, Italy. RF690

RADIO TRANSCRIPTION DISCS WANTED. W7F1Z, Box 724, Redmond, WA 98073-0274. RF700

FREE Ham Gospel Tracts. SASE. **N3FTT,** 5133 Gramercy, Clifton Heights PA 19018. RF960

CONNECTICUT'S favorite ham store. **ROGUS ELECTRONICS**, 250 Meriden-Waterbury Turnpike, Southington CT 06489. (203)621-2252. RF994

SECRET SCANNER Frequencies: Federal, Police, Aero, Military, Cellular, Surveillance, also SWL & CB Books. Big FREE catalog! **CRB RESEARCH**, Box 56-RF, Commack NY 11725. RF996

AMATEUR RADIO REPAIR!! All makes & models. Reasonable rates. **W7HBF, DAN RUPE,** 1302 S. Upland Dr., Camano WA 98292. (206)387-3558. RF999

Uncle Wayne's Bookshelf

BOOKS FOR BEGINNERS

02D42 **Digital Novice** *by Jim Grubbs* Geared to make you a more knowledgable participant. **$8.50**

01A87 **Shortwave Listener's Antenna Handbook** Primer antenna theory. **$13.95**

05C25 **Basic A.C. Circuits** A step-by-step approach for the beginning student. **$24.50**

20N018 **Technician Class License Manual: New No-Code** *by Gordon West* This book covers everything you need to become a Technician Class Ham. Every question and answer on the examinations is found in this one book. FCC Form 610 application. **$9.95**

20N092 **The Wonderful World of Ham Radio** *by Richard Skolnik, KB4LCS* Simple, clear, and fun. Introduces young people to amateur radio. **$7.95**

20N100 **Electronics Build and Learn (2nd Ed.)** *by RA Penfold* Combines theory and practice so that you can "learn by doing." **$12.50**

20N099 **Digital Electronics Projects for Beginners** *by Owen Bishop* Contains 12 digital electronics projects suitable for the beginner to build with the minimum of equipment. **$12.50**

AR2871 **W1FB's Help for New Hams** *by Doug DeMaw W1FB* Complete for the newcomer. Put together a station and get on the air. **$10.00**

AR2286 **First Steps in Radio** *by Doug DeMaw W1FB* Series of *QST* articles. **$5.00**

SHORTWAVE

06S57 **1993 Passport to World Band Radio** *by International Broadcasting Services, Ltd* You'll get the latest station and time grids. **$16.50**

03S11 **Shortwave Receivers Past and Present** *edited by Fred J. Osterman* Guide to 200+ shortwave receivers manufactured in the last 20 years. The Blue Book of shortwave radio value. **$8.95**

07R25 **The RTTY Listener** *by Fred Osterman* New and expanded. This specialized book compiles issues 1 through 25 of the *RTTY Listener Newsletter*. Contains up-to-date, hard-to-find information on advanced RTTY and FAX monitoring techniques and frequencies. **$19.95**

03C09 **Shortwave Clandestine Confidential** *by Gerry L. Dexter* Covers all clandestine broadcasting, country-by-country: tells frequencies, other unpublished information: spy, insurgents, freedom fighters, rebel, anarchist radio, secret radio. **$8.50**

03M221 **US Military Communications (Part 1)** US Military communication channels on shortwave. Covers frequencies, background on point-to-point frequencies for the Philippines, Japan and Korea, Indian and Pacific Oceans, and more. **$12.95**

03M222 **US Military Communications (Part2)** Covers US Coast Guard, NASA, CAP, FAA, Dept. of Energy, Federal Emergency Management Agency, Disaster Communications, FCC, Dept. of Justice. From 14 KC to 9073 KC. **$12.95**

03M223 **US Military Communications (Part 3)** Completes the vast overall frequency list of US Military services, from 8993 KC to 27,944 KC. **$12.95**

09S42 **The Scanner Listener's Handbook** *by Edward Soomre N2BFF* Get the most out of your scanner radio. **$14.95**

11T88 **Tune in on Telephone Calls** *by Tom Kneitel K2AES* Formatted as a frequency list with detailed description of each service and its location in RF spectrum. **$12.95**

03K205 **Guide to Radioteletype (RTTY) Stations** *by J. Klingenfuss* Updated book covers all RTTY stations from 3MHz-30MHz. Press, Military, Commercial, Meteo, PTTs, embassies, and more. **$12.95**

11AS10 **Air Scan Guide to Aeronautical Communications (5th Ed.)** *by Tom Kneitel K2AES* Most comprehensive guide to monitoring US aeronautical communications. Covers all Canadian land airports and seaplane bases, plus listings for Central America, the Caribbean, North Atlantic, and the Pacific Territories. **$14.95**

15A002 **Scanner and Shortwave Answer Book** *by Bob Grove* Most frequently asked questions by hobbyists. **$13.95**

07A66 **Aeronautical Communications Handbook** *by Robert E. Evans* Exhaustive, scholarly treatment of shortwave aeronautical listening. **$19.95**

11RF13 **The "Top Secret" Registry of US Government Radio Frequencies (7th Ed.)** *by Tom Kneitel K2AES* This scanner directory has become the standard reference source for frequency and other important information relating to the communications of federal agencies. **$19.95**

11F52 **Ferrell's Confidential Frequency List, New Revised Edition** *compiled by A.G. Halligey* All frequencies from 4 MHz-28MHz covering ship, embassy, areo, Volmet, Interpol, numbers, Air Force One/Two, more. **$19.50**

11SR97 **National Directory of Survival Radio Frequencies** *by Tom Kneitel K2AES* Handy and concise reference guide to high interest communications frequencies required by survivalists. **$8.95**

11SM11 **Scanner Modification Handbook, Vol. 1** *by Bill Creek* provides straightforward step-by-step instructions for expanding the operating capabilities of VHF scanners. **$17.95**

11EE06 **Guide to Embassy Espionage Communications** *by Tom Kneitel K2AES* Candid and probing examination of worldwide embassy and (alleged) espionage communications systems and networks. **$10.95**

20N094 **A Flick of the Switch, 1930-1950** *by Morgan E. McMahon* Discover the fast-growing hobby of radio collecting. **$8.95**

07R26 **World Wide Aeronautical Communications** *by Robert E. Evans* Aircraft/Air Traffic Control, Aircraft/Company Operations, Aviation Weather Broadcasts, Aeronautical Flight Tests, Worldwide Military Air Forces, Aero Search & Rescue, Aero Law Enforcement, NASA Flight Support, Aero Terms & Abbreviations and Aero Tactical Identifiers. **$6.95**

11T89 **Scanner Modification Handbook Vol. 2** *by Bill Creek* Here it is—a companion to Vol. 1. In fact, Vol. 2 has a section that provides improved approaches and updated techniques for the mods in Vol. 1. There's 18 new exciting modifications for popular scanners. **$17.95**

03R01 **World Press Services Frequencies (RTTY) New 5th Ed** A comprehensive manual covering radioteletype news monitoring—contains all information—antenna, receiving, terminal units, plus three extensive frequency lists. **$8.95**

ARRL BOOKS

AR1993 **ARRL 1993 Handbook (70th Ed.)** 39 chapters, featuring 2,100 tables, figures and charts. Comprehensive, well organized and affordable. **$25.00**

AR1086-4 **ARRL Operating Manual (4th Ed.)** Information on how to make the best use of your station, including: interfacing home computers. OSCAR, VHF-UHF. **$18.00**

AR0194 **Antenna Compendium Vol. 1** Materials on verticals, quads, loops, yagis, reduced size antennas, baluns, Smith Charts, antenna polarization. **$10.00**

AR2545 **Antenna Compendium Vol. 2** Covers verticals, yagis, quads, multiband and broadband systems, antenna selection. **$12.00**

AR4017 **Antenna Compendium Vol. 3** More verticals, yagis, quads, plus loops, arrays, mobile, direction finding, controlled currents, computerized, installation, overloads, plus 40 new articles for beginner's to advanced. **$14.00**

AR2626 **Companion Software for Antenna Compendium Vol. 2** 5 1/4" MS-DOS floppy. **$10.00**

AR0488 **W1FB's Antenna Notebook** *by Doug DeMaw W1FB* Get the best performance out of unobtrusive wire antennas and verticals. Build tuners and SWR bridges. **$9.50**

AR0348 **QRP Notebook** *by Doug DeMaw W1FB* Presents construction projects for the QRP operator. **$9.50**

AR4141 **W1FB's Design Notebook** *by Doug DeMaw W1FB* Filled with simple practical projects that can be built using readily available components and common hand tools. **$10.00**

AR2200 **Antenna Impedance Matching** *by Wilfred N. Caron* Most comprehensive book written on using Smith Charts in solving impedance matching problems. **$15.00**

AR0402 **Solid State Design** Good, basic information, circuit designs and applications; descriptions of receivers, transmitters, power supplies, and test equipment. **$12.00**

AR3193 **Weather Satellite Handbook (4th Ed.)** *by Dr. Ralph Taggart WB8DQT* Expanded and revised to reflect today's weather-fax satellite technology. **$20.00**

AR3290 **Companion Software for Weather Satellite Handbook** 5 1/4" MS-DOS Floppy. **$10.00**

AR3291 **Now You're Talking! All You Need To Get Your First Ham Radio License (2nd Edition)** A complete study guide for the Technican and Novice written exam. Practical information every beginner needs is written clearly and simply and in small doses. **$19.00**

AR3292 **Your Introduction to Morse Code: Practice Cassettes** Kit includes two 90 minute cassette tapes. Prepares you for the 5 WPM Morse code exam to earn your Novice license or add high-frequency worldwide communications privileges to your code-free Technician license. **$10.00**

AR0437 **ARRL Repeater Directory 1993-1994** 19,000+ listings with digipeaters, bandplans, CTCSS (PL(TM)) tone chart, frequency coordinators, ARRL special service clubs, and beacon listings from 14 MHz to 24GHz. **$6.00**

AR1033 **The DXCC Companion** *by Jim Kearman KR1S* Spells out in simple, straightforward terms what you need to be a successful DXer. **$6.00**

AR1250 **Log Book**—Spiral **$3.50**

ARA341 **Interference Handbook** RFI sleuth's experience in solving interference problems. **$12.00**

AR2197 **ARRL Data Book** Valuable aid to the RF design engineer, technician, radio amateur, and experimenter. **$12.00**

AR2960 **Transmission Line Transformers (2nd Ed.)** *by Dr. Jerry Sevick W2FMI* Practical designs and specific information on construction techniques and sources of material. **$20.00**

AR0410 **Yagi Antenna Design** *A Ham Radio* series polished and expanded by Dr. Lawson. **$15.00**

AR2171 **Hints and Kinks** Ideas for setting up your gear for comfortable, efficient operation. **$8.00**

AR3169 **QRP Classics** Compilation of ARRL publications on building receivers, transmitters, transceivers, accessories. **$12.00**

ARRL **License Manuals** Complete FCC question pools with answers.

AR2375	**Technician Class**	$6.00
AR2383	**General Class**	$6.00
AR0166	**Advanced Class**	$6.00
AR2391	**Extra Class**	$8.00

AR3185 **The Satellite Experimenter's Handbook, (2nd Ed.)** *by Martin Davidoff K2UBC* Expanded and revised. Focusing on satellites built by and for the international radio amateur community. **$20.00**

AR2456 **FCC Rule Book (9th Ed.)** A must for every active radio amateur. **$9.00**

AR2030 **Your Gateway to Packet Radio (2nd Ed.)** Tells everything you need to know about this popular new mode. **$12.00**

AR2103 **Satellite Anthology** The latest information on OSCARs 9 through 13 as well as the RS satellites, the use of digital modes, tracking antennas, RUDAK, microcomputer, and more! **$5.00**

AR2898 **Space Almanac** *by Anthony R. Curtis K3KXK* Recent news from space. **$20.00**

AR2083 **Complete DX'er (2nd Ed.)** *by Bob Locker W9KNI* Learn how to hunt DX and obtain hard-to-get QSL cards. **$12.00**

AR2065 **ARRL Antenna Book** The new 16th Edition represents the best and most highly regarded information on antenna fundamentals, transmission lines, design, and construction of wire antennas. **$20.00**

AR3293 **Morse Code: The Essential Language** *by L. Peter Carron Jr. W3OKV* Expanded and revised in its 2nd edition. How to handle distress calls heard not only on the hambands but on maritime and aircraft frequencies. **$6.00**

AR4114 **Low Profile Amateur Radio** For the Ham who lives where antennas are frowned upon. From hiding your antenna to operating with low power. This book tells you how to get on the air using these techniques—and others—without calling attention to yourself. **$8.00**

STUDY AIDS

VIS Study Cards Compact, up-to-date Flash Cards with Key Words, Underlined, Quiz on back. Formulas worked out. Schematics at your fingertips. Used SUCCESSFULLY by ages 6 to 81!

NOVICE	VIS01	$11.95
TECH	VIS02	10.95
GENERAL	VIS03	9.95
ADVANCED	VIS04	15.95
EXTRA	VIS05	14.45

REFERENCE

20N102 **Practical Digital Electronics Handbook** *by Mike Tooley BA* Contains nine digital test gear projects. Digital circuits, logic gates, bistables and timers, microprocessors, memory and input/output devices. **$14.50**

20N103 **Electronic Power Supply Handbook** *by Ian R. Sinclair* Covers many types of supplies—batteries, simple AC supplies, switch mode supplies and inverters. **$16.25**

20N104 **Electronic Test Equipment Handbook** *by Steve Money* A guide to electronic test equipment for the engineer, technician, student and home enthusiast. **$18.00**

20N105 **Digital Logic Gates and Flip-Flops** *by Ian R. Sinclair* A firm foundation in digital electronics. Treats the topics of gates and flip-flops thoroughly and from the beginning. **$18.00**

01C80 **Master Handbook of 1001 Practical Electronic Circuits** Tried and proven solid state circuits. **$19.95**

01P68 **Pirate Radio Stations** *by Andrew Yody* Tuning in to underground broadcasts. **$12.95**

01T01 **Transmitter Hunting** *by Joseph Moell and Thomas Curlee* Radio direction finding simplified. **$19.95**

03R02 **Rtty Today** *by Dave Ingram* Modern guide to amateur radioteletype. **$8.50**

05E03 **First Book of Modern Electronics** Unique projects that are money saving. **$12.95**

09D22 **The World Ham Net Directory** *by Mike Witkowski* New—2nd edition. Introduces the special interest ham radio networks and shows you when and where you can tune them in. **$9.50**

09P33 **Pirate Radio Directory** *by George Zeller* Where to tune in on secret entertainment stations. **$7.95**

10F093 **1993 International Callbook** The new 1993 International Callbook lists 500,000+ licensed radio amateurs in the countries outside North America. It covers South America, Europe, Africa, Asia, and the Pacific area (exclusive of Hawaii and the U.S. possessions). **$29.95**

10D093 **1993 North American Callbook** The 1993 North American Callbook lists the calls, names, and address information for 500,000+ licensed radio amateurs in all countries of North America. **$29.95**

05H24 **Radio Handbook, 23rd Ed.** *by William I. Orr W6SAI* 840 pages of everything you wanted to know about radio communication. **$39.95**

02B10 **Heath Nostalgia** *by Terry Perdue K8TP* 124 page illustrated history of the Heath Company. Includes many fond memories contributed by long-time Heathkit employees. **$9.50**

10DF92 **1993 Callbook Supplement** An update to the 1992 International and American callbooks. **$10.00**

12E76 **Basic Electronics** *Prepared by the Bureau of Naval Personnel* Covers the important aspects of applied electronics and electronics communications. **$10.95**

12E41 **Second Level Basic Electronics** *Prepared by the Bureau of Naval Personnel* Sequel to Basic Electronics, thorough treatment of the more advanced levels of applied electronics. **$9.95**

01D45 **The Illustrated Dictionary of Electronics, 5th Ed** *by Rufus P. Turner and Stan Gibilisco* An exhaustive list of abbreviations, and appendices packed with schematic symbols and conversion tables. **$26.95**

20N091 **Most-Often-Needed Radio Diagrams and Servicing Information, 1926-1938, Volume One** *compiled by M.N. Beitman* An invaluable reference for anyone involved in Vintage Radio restoration. **$11.95**

20N096 **How To Read Schematics (4th Ed.)** *by Donald E. Herrington* Written for the beginner in electronics, but it also contains information valuable to the hobbyist and engineering technician. **$14.95**

20N097 **Radio Operator's World Atlas** *by Walt Stinson, W0CP* This is a compact (5x7), detailed, and comprehensive world atlas designed to be a constant desk top companion for radio operators. **$17.95**

20N020 **Secrets of RF Circuit Design** *by Joseph J. Carr* Written in clear non-technical language, covers everything from antennas to transistors. **$19.50**

20N109 **73 Magazine Index 1960-1990** A complete index to every article published in *73 Magazine* through 1990. Book **$15.00** IBM software (specify type) **$20.00**

20N110 **Product Reviews Since 1945** Contains an index to 3,400 product reviews that have appeared in *QST, CQ, HR, 73* and *Radcom*. Book **$12.95** IBM Software 5.25 **$10.00**

WAYNE'S PICKS

SS8756 **Warning! The Electricity Around You May Be Hazardous To Your Health** *by Ellen Sugarman* An invaluable guide to the risks of electromagnetic fields, and steps you can take to protect yourself and your family. **$11.00**

"We The People" Declare War! On Our Lousy Government. *by Wayne Green* A "must read" for every american taxpayer. Solutions to every problem facing our government today. **$12.95**

ED86751 **Dumbing Us Down: The Hidden Curriculum Of Compulsory Schooling.** *by John Gatto* If you enjoyed "Declare War", you'll enjoy this also. A Wayne Green recommended reading.**9.95.**

NEW STUFF

AR3762 **Your QRP Operating Companion** No special rigs or expensive equipment to enjoy the excitement and challenge of low-power operating. **$6.00**

AR3878 **Your VHF Companion** Explore the fascinating activities on the VHF bands: FM and repeater, packet, CW, & SSB, satellites, ATV, transmitter hunting, and more. **$8.00**

AR3959 **Your Packet Companion** Perfect for the packet newcomer. **$8.00**

UHF/VHF PACKET

01P22-2 **The Packet Radio Handbook (2nd Ed.)** *by Jonathan L. Mayo KR3T* "...the definitive guide to amateur packet operation."—Gwyn Reedy W1BEL **Only $16.95**

09V11 **The Basic Guide to VHF/UHF Ham Radio** *by Edward M. Noll* Provides a first rate introduction to the 2.6 and 1.25 meter bands as well as 23, 33, and 70cm. **$6.50**

20N019 **U.S. Repeater Mapbook** *by William Smith N6MQS* The Guide for traveling radio amateurs. **$9.95**

03R02 **RTTY Today** *by Dave Ingram K4TWJ* Most comprehensive RTTY guide ever published. **$8.50**

ANTENNAS

20N108 **The Easy Wire Antenna Handbook** *by Dave Ingram K4TWJ.* Gives you all of the needed dimensions for a full range of easy to build and erect "sky wires." **$9.50**

01A70 **Practical Antenna Handbook** *by Joseph J. Carr* Design, build, modify, and install your own antennas. **$22.95**

10A342 **All About Verticle Antennas** *by William Orr* Comprehensive coverage of amateur communications. **$10.95**

10A343 **All About Cubical Quad Antennas** *by William Orr and Stuart Cowan* "The Classic" on Quad design, theory, construction, operation. New feed and matching systems. New data. **$11.95**

10A345 **Beam Antenna Handbook** *by William Orr and Stuart Cowan* Everything you need to know about beam design, construction, and operation. **$11.95**

10A346 **Simple, Low-Cost Wire Antennas For Radio Amateurs** *by William Orr and Stuart Cowan* All New! Low-cost, multi-band antennas; inexpensive beams, "Invisible" antennas for hams in "tough" locations! New data. **$11.95**

SOFTWARE

04M54 **GGTE Morse Tutor** From beginner to Extra class in easy self-paced lessons. Code speeds from 1 to over 100 words per minute. Standard or Farnsworth mode. Adjustable tone frequency. Create your own drills, practice or actual exams. Exams conform to FCC requirements. 5 1/4" floppy for IBM PC, XT, AT, PS/2 or compatibles. **$19.50**

04M55 **Advanced Edition** **$29.95**

20N021 **No Code Ham Radio Education Package** Computer software package. Includes computer aided instruction software (IBM compatible), 200 page Ham Radio Handbook. **$28.95**

20N022 **Ham Operator Education Package** Computer software contains five IBM compatible discs with all questions for all license classes, plus "Morse Academy" code teaching software that takes you from 0-20 wpm. **$28.95**

Lanze Code Programs—(Available on 5 1/4" disk.) Inexpensive complete study guide code programs for both the C64/128 Commodores and the IBM compatibles. Programs include updated FCC questions, multiple choice answers, formulas, schematic symbols, diagrams, and simulated (VE) sample test.

	IBM Part#	Commodore Part#	Price
Novice	IBM01	COM01	$14.95
Tech	IBM02	COM02	$14.95
General	IBM03	COM03	$14.95
Advance	IBM04	COM04	$19.95
Extra (New Pool)	IBM05	COM05	$19.95

IBM06, COM06 IBM/Commodore Tech No Code—Lanze Code Program Contains all the authorized FCC questions and answers used in testing formulas, schematic symbols, diagrams, and sample test for passing the new Technician No Code license. **$24.95**

IBM97 **Amateur Radio Part 97 Rules** New Edition, complete FCC rules. **$9.00**

CODE TAPES

73T05 **"Genesis"** **$5.95**
5 wpm—This beginning tape, takes you through the 26 letters, 10 numbers, and necessary punctuation, complete with practice every step of the way.

73T06 **"The Stickler"** **$5.95**
6+ wpm—This is the practice tape for those who survived the 5 wpm tape, and it's also the tape for the Novice and Technician licenses. It is comprised of one solid hour of code. Characters are set at 13 wpm and spaced at 5 wpm.

73T13 **"Back Breaker"** **$5.95**
13+ wpm—Code groups again, at a brisk 13+ wpm so you'll be really at ease when you sit down in front of a steely-eyed volunteer examiner who starts sending you plain language code at only 13 per.

73T20 **"Courageous"** **$5.95**
20+ wpm Congratulations! Okay, the challenge of code is what's gotten you this far, so don't quit now. Go for the extra class license. We send the code faster than 20 per.

Uncle Wayne's Bookshelf Order Form

You may order by mail, telephone, or fax. All payments are to be in US funds. Allow 3 weeks for delivery.

Item #	Title	Qty.	Price	Total

SHIPPING
TOTAL

Shipping: All orders add $5.00 shipping. U.S. orders shipped UPS. (Alaska & Hawaii shipped via mail.) Airmail to Canada and all overseas orders FOB Peterborough, NH. Make checks payable to "Uncle Wayne's Bookshelf."

Name _____

Street _____

City _____ State _____ Zip _____

TOTAL $ ☐AE ☐MC ☐VISA ☐Check/Money Order

Card # _____ Expiration Date _____

Mail: *73 Magazine,* Attn. Uncle Wayne, PO Box 3080, Peterborough, NH 03458
Telephone: (603) 924-4196 (800) 234-8458 FAX: (603) 924-8613

RF1093

new products

PIONEER HILL SOFTWARE

Hams with a personal computer using Microsoft Windows 3.1 and a Sound Blaster or compatible sound board will appreciate having an Audio Spectrum Analyzer at their fingertips. This new program allows you to analyze audio signals in near real time by digitizing the audio using the sound board, performing a Fast Fourier Transform (FFT) and displaying the resulting spectra. The program makes good use of the Windows graphics environment—clicking the left mouse button on a peak shows its frequency; pressing the right mouse button and dragging between two peaks measures the frequency offset.

The user can select the FFT size, sampling rate, and mark key frequencies. Its averaging mode is especially useful as random noise is reduced to allow the signal characteristics to be more clearly discerned. In fact, injecting white noise into the antenna terminals and averaging for a few minutes will show the radio filter's response. The program sells for $39. For more information, please contact: *Pioneer Hill Software, 24460 Mason Rd., Poulsbo WA 98370; (206) 697-3472.* Or circle Reader Service No. 201.

AEA

AEA has recently introduced the IT-1 AutoTuner, an accessory for their popular IsoLoop 10-30HF antenna. The IsoLoop is a high quality, high efficiency antenna with a mere 35-inch diameter.

The IT-1 AutoTuner will automatically tune an IsoLoop in just a few seconds. When more control is necessary, there is a thumbwheel for manual tuning and fine adjustments.

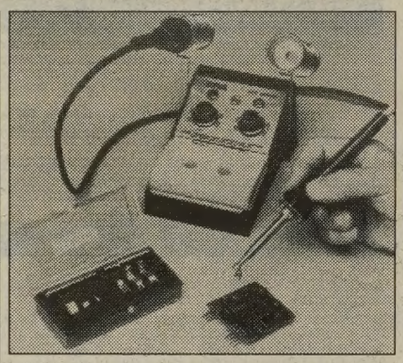
The IT-1 AutoTuner features a 12-button keypad with an audible beep to announce completion of tuning. It has eight programmable memories, as well as a 10-segment LED bar that monitors the tuning process and indicates the selected memory number. Memory backup and a built-in serial interface are also included.

The suggested retail price is $279 at your local amateur radio dealer. The unit comes with a one-year warranty. For more information contact: *Advanced Electronic Applications, P.O. Box C2160, Lynnwood WA 98036; (206) 774-5554, Fax: (206) 775-2340.* Or circle Reader Service No. 203.

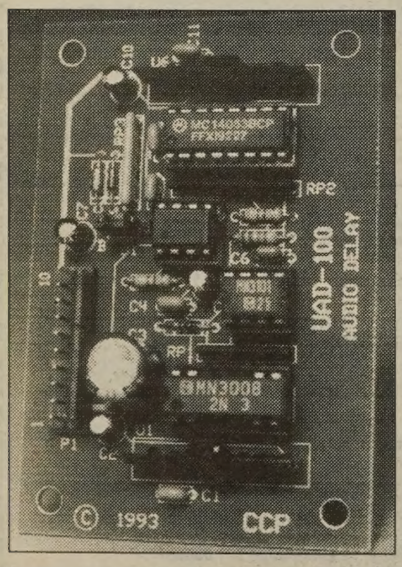
THE TOOL RESOURCE

Hexacon's HTC Series Soldering Stations are now available at The Tool Resource. These provide superior thermal capacity and outperform other soldering stations at an economical price. The heating elements are located in the tips for quick temperature response. The units are built to be spike- and static-free, well-grounded, and ESD-safe.

The clever sponge holder includes a dross tray which eliminates the need to touch the potentially hazardous metal material. It holds three times as much water as ordinary sponge trays. A wide selection of tips are available, and custom tips can be ordered.



For more information, contact: *The Tool Resource, P.O. Box 1106, W. Dundee, IL 60118; Voice or Fax: (708) 468-0849.* Or circle Reader Service No. 205.



CREATIVE CONTROL PRODUCTS

Here is a brand-new, low-cost, easy-to-interface repeater audio interface circuit from Creative Control Products. The UAD-100 Universal Audio Delay board features complete DTMF tone mute, and squelch tail elimination.

This board is inserted in the repeater receiver audio path before any audio switching circuitry. It then delays the audio before it arrives in the repeater transmitter, resulting in a pleasant-sounding transmitter drop. No more crashing, clunking, or snapping. Finally: a great sounding system, made easy.

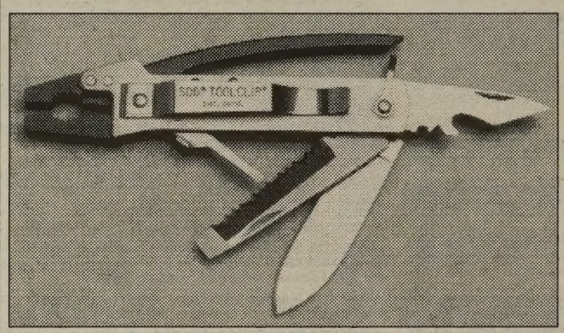
The UAD-100 comes fully-assembled and tested with a detailed application manual and one-year warranty for $99. For more information, please contact: *Creative Control Products, 3185 Bunting Avenue, Grand Junction CO 81504; (303) 434-9405.* Or circle Reader Service No. 206.

j•COM

DXers will be impressed at how easy it is to use the new j•Com W9GR DSP-II Audio Filter. A single rotary switch selects any one of the 11 available filters on this dandy.

Now available for use by SSB operators are four filters which enhance the intelligibility of speech signals while reducing hiss, static, ignition and power-line noise, white and pink noise, and other random interference. For CW operators, four brick-wall linear-phase 120th order FIR bandpass filters will extract the weakest signals from adjacent QRM. Three special use bandpass filters are also provided: 2075-2345 Hz for RTTY, 1550-1850 Hz for HF packet, and 1150-2350 Hz for SSTV.

A 10-segment bar graph displays the input audio signal level for performance optimization. The gain control is adjustable for comfortable listening. A 2 watt amplifier is built into the unit to drive the external speaker. The W9GR DSP II Audio Filter installs easily between the receiver speaker output and an external speaker. It's being introduced at $299.95 plus $5 S&H in the US ($15 S&H overseas). For more information contact: *j• Com, 793 Canning Parkway, Victor NY 14564; (716) 924-0422, Fax: (716) 924-4555.* Or circle Reader Service No. 202.



JENSEN TOOLS

Wouldn't it be nice to always have an entire tool chest right at your fingertips? Well, now you can have the next best thing—the new SOG ToolClip from Jensen Tools, Inc. This unique pocket tool combines 13 functions in one neat little package.

The SOG ToolClip features a full-jaw pliers, a combination gripper and wire cutter that can easily handle chain link fencing, a razor-sharp spear-point blade, a utility blade, a serrated-edge blade, a pair of screwdrivers, a pair of wire strippers, a file, a pry bar, and a bottle opener, all in a sturdy housing complete with a belt clip. The pliers, wire cutters, and grippers can all be accessed with only one hand—a mighty helpful feature when climbing towers or holding materials.

The SOG ToolClip is constructed of durable stain-resistant steel and is guaranteed for life against defective workmanship and materials. The price is $59.95. For more information, or to receive a free catalog, contact: *Jensen Tools Inc., 7815 S. 46th St., Phoenix AZ 85044; (602) 968-6231.* Or circle Reader Service No. 204.

TRIMBLE NAVIGATION

You'll never get lost again with Trimble Navigation's satellite-based hand-held GPS (Global Positioning System) Scout. It is perfect for amateur radio applications, search and rescue, backpacking, and off-road driving. The low-cost Scout GPS receives positioning data from 24 orbiting satellites to pinpoint your location around the clock, anywhere on earth, in any weather.

The GPS was designed and developed by the US Department of Defense to benefit both military and civilian users. Hams will enjoy the Scout GPS, which is based on the Maidenhead Grid Locator, displaying location information in language familiar to many amateurs. Scout uses the ARRL's grid square locator technique.

The Scout GPS kit contains four AA batteries, a user's manual, cordura carrying case, lanyard, and the Trimble Atlas. The whole package retails for $795 and an external antenna kit accessory is available for $150. For more information contact: *Trimble Navigation, 645 North Mary Avenue, P.O. Box 3642, Sunnyvale CA 94088-3642; (408) 481-8000, Fax: (408) 730-2997.* Or circle Reader Service No. 207.

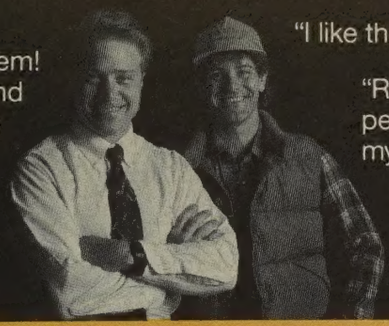
FT-2200/7200
2-m/70-cm Mobiles

- **Frequency Coverage:**
  FT-2200
  RX: 110-180 MHz
  TX: 144-148 MHz
  FT-7200
  RX/TX: 430-450 MHz
- 50 Memory Channels
- Wide Receiver Coverage: 110-180 MHz
- AM "Aircraft" Receive: 110-139 MHz
- Built-In DTMF Paging/Coded Squelch
- Power Output 50/25/5 Watts
- CTCSS Encode Built-In
- 10 Memory DTMF Auto Dialer
- Selectable Channel Only Display
- Remote Operation w/ Optional MW-2
- Optional Digital Voice Storage System
- Backlit DTMF Mic
- **Accessories:**

FTS-27	CTCSS Decode Unit
DVS-3	Digital Voice System Unit
MW-2	Remote Control/ Wireless Mic
SP-7	External Speaker

"The FT-2200 answers my problem! It fits anywhere, and the 3 power levels are great!"

"Yaesu did it again!"



"I like the FT-2400H!"

"Rugged performance is my answer!"

FT-2400/7400H
2-m/70-cm Mobiles

- **Frequency Coverage:**
  FT-2400H
  RX: 140-174 MHz
  TX: 144-148 MHz
  FT-7400H
  RX/TX: 430-450 MHz
- Rugged Mil-Spec Design
- Advanced Track Tuning (ATT)
- 31 Memory Channels
- Wide Receiver Coverage: 140-174 MHz
- Selectable Alpha-Numeric Display
- Largest 2-Meter Display Available
- CTCSS Encode Built-In
- Power Output 50/25/5 Watts
- Flip Up Front Control Panel Hides Seldom Used Buttons
- Backlit DTMF Mic
- **Accessories:**

FTS-17A	CTCSS Decode Unit
FRG-6	DTMF Paging Unit
SP-4	External Speaker
FP-700	Power Supply

For your sleek compact car, the sculptured FT-2200 looks terrific. With leading-edge features, performance and reliability too, it's the perfect answer to your 2-m needs.

At 5.5"W x 1.6"H x 6.5"D the FT-2200 installs nearly anywhere. And, it does "lead" with features like optional Remote Control Wireless Mic – first in the world for any 2-m mobile and AM Aircraft Receive – first in a Yaesu mobile. Performance? The FT-2200 has more than twice the memories of the competition! Reliability? Its bright, new LCD display and backlit DTMF Mic makes night mobiling safe. Features, performance, reliability – in a powerful little package. See your dealer for *this* answer to your 2-m needs.

The Yaesu FT-2400H set the standard by which all 2-m mobiles are judged. The first and only amateur radio to pass rugged MIL STD 810D tests for shock and vibration, its one-piece die-cast chassis with extra large heat sink gives years of trouble-free operation.

With 50 watts of TX power, large alpha-numeric display, auto display dimmer, exclusive backlit DTMF Mic and advanced track tuning front end for superior receiver performance, the popular FT-2400H is the choice of amateurs in the know.

Features, performance, reliability – ready to go anyplace. See your dealer for *this* answer to your 2-m needs.

NEW

Yaesu answers your 2-m mobile needs.

YAESU

Performance without compromise.™

A New Way To Learn About A New Radio:

1-206-450-6088

ICOM's new 2iA is *so* new, and *so* different, we had to find a new and different way of telling you about it. Introducing *I-COM LINE.* Your hotline for new radio info!

The NEW! *I-COM LINE*

No buttons, no hassles, pure fun!

Our I-COM LINE is free, it's fun, and it's the best way ever of making intelligent radio buying decisions.

Here's all you do:

1. Dial 1-206-450-6088.

2. Leave your name, address, and the name of the product you're interested in – in this case, the 2iA.

Within 24 hours, we'll send you REAL info about the 2iA: how and why it was designed, spec sheets, field tests, reviews – everything you need to decide if this is the radio for you.

Give it a try! See how easy it is to communicate with the world leader in amateur radio communications.

I-COM LINE: uniquely ICOM!

Actual size!

The NEW! *IC-2iA*

No buttons, no hassles, pure fun!

Tiny on the outside, lots of radio on the inside. We challenged our designers to build the smallest, lightest, *skinniest* handheld ever – but without sacrificing the big-radio features. Putting a big radio in a small space meant that something had to go.

Not the big display, of course.

Not the super audio speaker.

And we obviously couldn't cut corners on features and still call it an ICOM.

So we got rid of the buttons.

When you really think about it, you want what buttons do, not necessarily the buttons themselves, right?

So we put the controls on the inside, where they belong.

To find out how we did it and how it works, call the I-COM LINE

The IC-2iA: uniquely ICOM!

ICOM's HT Family – also available on the I-COM LINE!

P Series
P2AT - 2M
P3AT - 220MHz
P4AT - 440MHz

SRA Series
2SRA - 2M/WideBand Receiver,
4SRA - 440MHz/WideBand Receiver

SAT Series
2SAT - 2M
3SAT - 220MHz
4SAT - 440MHz

GAT Series
2GAT - 144MHz
4GAT - 440MHz
12GAT - 1.2GHz

0AT Series
02AT - 2M
03AT - 220MHz

Dual Band
W2A - 2M/440MHz
W21 - 2M/440MHz
X2A - 440MHz/1.2GHz
24AT - 2M/440MHz

AT Series
2AT - 144MHz